

**BEYOND NUNN-LUGAR:
CURBING THE NEXT WAVE OF WEAPONS
PROLIFERATION THREATS FROM RUSSIA**

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Nonproliferation Policy Education Center

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Abstract The chapters in this book were originally commissioned by the Nonproliferation Policy Education Center (NPEC) as part of a study on the future of U.S.-Russian nonproliferation cooperation. This book is different from other studies of U.S.-Russian cooperation because it relies on competitive strategies, which detail how best to pit one's strengths against a competitor's weaknesses in a series of moves and countermoves. The goal is to devise strategies that force one's competitor to spend more time and resources shoring up his weaknesses than in taking offensive action.		
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CONTENTS

Introduction	
<i>Henry D. Sokolski</i>	v
Acknowledgements	xi
Chapter 1. Beyond Nunn-Lugar: Curbing the Next Wave of Weapons Proliferation Threats from Russia	
<i>Working Group on U.S.-Russian Nonproliferation Cooperation</i>	1
Chapter 2. The Foundations of Russian Strategic Power and Capabilities	
<i>Stephen J. Blank</i>	25
Chapter 3. Russian Rule and the Regional Military Industrial Complexes	
<i>Ariel Cohen</i>	57
Chapter 4. The Health and Future of Russia's Population	
<i>Murray Feshbach</i>	83
Chapter 5. New Metrics for Denuclearization	
<i>Thomas B. Cochran</i>	99
Chapter 6. Demilitarizing Russian Weapons Scientists: The Challenge	
<i>Mark Kramer</i>	115
Chapter 7. Defense Conversion: How Far Can Russia Expand Small and Medium Enterprises?	
<i>Matthew Partan</i>	195
Chapter 8. Turning the Next Generation of Russians Away from Weapons Work	
<i>Thomas Riisager</i>	241
About the Contributors	259

INTRODUCTION

Although the present book never intended to be quite so timely, *Beyond Nunn-Lugar: Curbing the Next Wave of Weapons Proliferation Threats from Russia* is one book that, coming so soon after the events of September 11, 2001, and shortly before President Bush's Russian summit, should find a ready audience. The essays in the book were originally commissioned by the Nonproliferation Policy Education Center (NPEC) as part of a year-long study on the future of U.S.-Russian nonproliferation cooperation. What makes the book different from other studies of U.S.-Russian cooperation is its reliance on competitive strategies.¹

Originally devised as a business management tool and subsequently used by the Pentagon to guide its military planning against the Soviet Union, the analytical approach based on competitive strategies requires analysts to evaluate long-term trends, 10 to 20 years out. Rather than beginning with one's own aims and strategies, however, competitive strategies demands that analysts first understand the objectives, strengths, and weaknesses of competitors and other key parties. A key objective of competitive strategies is to detail how best to pit one's strengths against a competitor's enduring weaknesses in a series of moves and countermoves. The goal is to devise strategies that force one's competitor to spend more time and resources shoring up his weaknesses than in taking offensive action.

Although businesses and other organizations generally use competitive strategies analysis to secure advantage over their challengers, it also can be used to help them identify beneficial opportunities for cooperation. To date, this has not been the approach U.S. officials have taken on nonproliferation cooperation with Russia. Instead, they have assumed that the specifics of cooperation should be

determined by whatever goals and strategies Russia and the United States share. This book takes a very different approach. The authors first focus on how Russia's and America's proliferation-related strategies and goals differ. They then identify each nation's relevant strengths and weaknesses and determine where these might best be mated to produce new forms of cooperation.

An example of what this kind of analysis is capable of producing can be found in the first chapter, the final report of the competitive strategies working group on U.S.-Russian nonproliferation cooperation. Here the different goals of each nation regarding medical and health services are identified. Russia still has a good number of biological weapons-related experts that it has yet to find civilian employment for, but a relatively poor level of medical services. It also has a population whose health is seriously deteriorating and a Russian president who wants to change this. Finally, although the availability of medical services is very low, Russia still has a fairly competent, functioning public health system.

In contrast, provision of medical services in the United States is quite high, but America's public health system is barely functional. Unlike Russia, it has few, if any, biological weapons experts, but it is very concerned about being able to detect the use of biological weapons and the spread of dangerous diseases and pathogens within America and from other nations (including Russia).

After reflecting on these issues and the commissioned research of health demographer Murray Feshbach reported in Chapter 4 ("The Health and Future of Russia's Population"), the working group focused on the prospects for U.S.-Russian cooperation on health monitoring both to enhance the health of Russia's population and to increase the chances of detecting the spread of dangerous diseases caused by either nature or the hand of man. One of the nation's leading health surveillance experts, Dr. Alan Zelicoff of Sandia National Laboratory, was brought in to

brief the group about a health monitoring system already operating in New Mexico known as Rapid Syndrome Validation Project, or RSVP.

RSVP uses computers, touch-screen entry, and the Internet to enable physicians to make speedy reports to public health authorities when they encounter patients who have a particular set of symptoms. A physician's report can be filed in less than a minute, assumes no prior knowledge of exotic diseases, and can address over 90 percent of the diseases a biological-weapons attack might spread. The system is also cheap to deploy—an entire global system of 10,000 reporting stations could be put in place for between 10 and 20 million dollars.

After learning this and more about RSVP, the working group recommended that the U.S. Government support RSVP's deployment in Russia as a cooperative threat reduction effort and that the United States use biological weapons experts at Russia's former biological weapons research laboratories to set up and run the system. NPEC staff subsequently briefed this recommendation to U.S. officials in the Departments of Defense and Energy. As a result, both departments agreed early in 2002 to fund deployment of RSVP in Russia and several former Soviet Republics.

The working group also made several other recommendations. One set had to do with how best to account for Russian nuclear weapons materials and to help pay for reducing the threats they and other Russian strategic weapons activities present. Discussion of this set of recommendations, which focused on allowing Russia to earn money storing U.S.-origin spent fuel from East Asia and Europe in exchange for better data on its nuclear inventory and the use of profits to help pay for important Nunn-Lugar programs, also can be found in Chapter 1. In making these recommendations, the working group benefited from the analyses of Army War College researcher Dr. Stephen Blank ("The Foundations of Russian Strategic

Power and Capabilities,” Chapter 2); of Heritage Foundation’s Russian Studies Director Dr. Ariel Cohen (“Russian Rule and the Regional Military Industrial Complexes,” Chapter 3); and of the Natural Resource Defense Council’s Dr. Thomas Cochran (“New Metrics for Denuclearization,” Chapter 5).

Finally, the working group made a set of recommendations regarding the next generation of Russian strategic weapons workers. This set of recommendations, which focused on increasing the quantity and quality of Russian and Western student exchanges, turned heavily on the analysis found in Chapter 6 by Professor Mark Kramer of Harvard University (“Demilitarizing Russian Weapons Scientists: The Challenge”); in Chapter 7 by Centra Technologies’ Matthew Partan (“Defense Conversion: How Far Can Russia Expand Small and Medium Enterprises?”); and Chapter 8 by this book’s coeditor and NPEC’s Wohlstetter Fellow, Thomas Riisager (“Turning the Next Generation of Russians Away from Weapons Work”).

None of these chapters makes for breezy reading. However, given how high the costs of U.S.-Russian nonproliferation cooperation failure might be—terrorist access to weapons materials and the further proliferation of strategic arms to unstable, hostile states—they are all too timely and deserve to be read with care.

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ENDNOTE - INTRODUCTION

1. Henry D. Sokolski, ed., *Prevailing in a Well-Armed World*, Carlisle Barracks, PA: Strategic Studies Institute, March 2000, pp. 1-26.

ACKNOWLEDGEMENTS

Because this volume is the result of a year-long study of the future of U.S.-Russian nonproliferation cooperation, more than just authors and editors were required. First, the project itself had to be funded. Here, as has been the case since the inception of the Nonproliferation Policy Education Center (NPEC), the Smith Richardson Foundation underwrote nearly the entire effort. The balance was secured from the U.S. Air Force's Institute of National Security Studies. Without the generous support of these two foundations, there would have been no project. In addition, the current and previous chairman of the Army War College's Department of National Security and Strategy—Professors Robert “Robin” Dorff and Joseph Cerami—played a critical role in securing the support of the U.S. Army War College's Strategic Studies Institute, which in turn was responsible for this book's publication and posting it on the internet. Without their help, there would be no book.

The actual work of the book was done by those NPEC commissioned to write papers and by those who participated in a series of workshops at which these critical essays were discussed. The authors' essays are in this book. As important as their contributions were, those of the workshops' group leaders—Dr. Jacob Kipp of the U.S. Army Training and Doctrine Command, Dr. Bill Green of the National Security Studies Program at the University of California at San Bernardino, and Dr. Mark Kramer of the Davis Center for Russian Studies at Harvard were equally important. These scholars kept all of the participants focused on the project's key issues.

Finally, a special word of thanks is due to Tom Riisager, the center's Wohlstetter Fellow and research coordinator, who ran the project and marshaled the book into its final form. Tom worked long hours—many more than could be

reasonably asked. Without his efforts and close work with Ms. Marianne Cowling of the Strategic Studies Institute, this edited volume would not have been possible.

CHAPTER 1

BEYOND NUNN-LUGAR: CURBING THE NEXT WAVE OF WEAPONS PROLIFERATION THREATS FROM RUSSIA

Working Group on U.S.-Russian Nonproliferation Cooperation

Foreword.

With so many analyses already available of U.S.-Russian cooperative threat reduction efforts, it is not obvious why one should bother with yet another. There are, however, three good reasons for doing so. First, with the recent warming in U.S.-Russian relations, it makes sense to review what is clearly the current mainstay of existing U.S.-Russian cooperation—the one billion dollars per year worth of government-funded Nunn-Lugar programs—to see what can be done better. Certainly, if the Cooperative Threat Reduction Program’s worthy objectives can be better achieved, this, in turn, should enhance the prospects for increased U.S.-Russian security cooperation generally. Of course, the reverse is also true.

Second, although there is broad support to continue these programs, there is a growing divide between the programs’ backers and their critics as how best to proceed. Among the programs’ supporters, the key recommendation is to spend substantially more on existing projects. Critics of the programs’ defense conversion efforts, however, insist

that these projects be made self-sustaining as soon as possible.

Finally, since September 11, 2001, the inventory of threats that the United States and Russia need to cooperate on reducing has clearly grown.

Overview.

The current centerpiece of U.S.-Russian security collaboration is the Nunn-Lugar Cooperative Threat Reduction Program. Costing nearly a billion dollars annually, this effort and the projects it supports have run for nearly a decade now and gained the kind of political, bureaucratic, and budgetary support that has all but institutionalized them. Indeed, not only are they likely to continue for many more years, their success or failure has become identified with the future of U.S.-Russian cooperation generally.

Looking at the current state of these programs, it is easy to see why. On the one hand, they have succeeded in helping Russia pay for the dismantlement and securing of a significant number of deployed strategic weapons systems and related research, production, and storage facilities. What they have yet to extend to, however, are the most worrisome of Russia's strategic weapons activities—Moscow's continued proliferation of missile and nuclear technology exports to those nations still at odds with the United States, e.g., Iran, Iraq, and China.

Thus, at the very time Nunn-Lugar supporters were trying to secure \$316 million more in funding, Russian President Vladimir Putin signed a major security treaty of friendship with China and a \$300 million arms deal with Iran. Russian nuclear and missile cooperation with Tehran, moreover, continues. Indeed, some now believe that Iran is so far along in its nuclear missile efforts that, even if Russia cut off all further assistance, Tehran could deploy a long-range nuclear system in the next 5 to 8 years. As for

Iraq, Putin recently sent an official delegation to meet with Iraqi President Saddam Hussein to assure Baghdad of Moscow's continued interest in resuming arms sales and military cooperation just as soon as the United Nations sanctions are lifted.

As U.S.-Russian cooperative threat reduction efforts succeed or fail in demilitarizing and controlling the further spread of U.S. and Russian strategic weapons capabilities, then, so too does the fate of U.S.-Russian security cooperation generally rise or fall. Beyond Russia and the United States backing the goals of Nunn-Lugar and acting in good faith, though, success in these efforts also requires sound cooperative programs and proper implementation. In this regard, congressional hearings, General Accounting Office studies, and several official reviews have highlighted a number of concerns. Among these are:

- U.S. assistance to demilitarize Russia's strategic weapons production and research institutes has been so poorly monitored that, in some cases, it could have actually helped to maintain Russia's weapons capabilities;
- The metrics for these programs' success and failure are egregiously vague;
- Despite years of spending to encourage defense conversion, there is little to show in the way of commercial Russian venture enterprises;
- The costs to the U.S. taxpayer for many of the defense conversion programs are growing despite congressional calls for the executive branch to devise ways to defederalize their support.

This listing of worries brings us to the last reason that a reassessment of the cooperative threat reduction programs is warranted. After September 11 and a decade of implementing the current crop of Nunn-Lugar programs, the list of threats U.S.-Russian threat reduction

cooperation must now address has grown. In 1991, the immediate proliferation concern was the likely spread of Russia's existing nuclear weapons materials and long-range missile expertise to Iran or Iraq. Now, U.S.-Russian cooperative threat reduction efforts need to address at least three other longer-term worries:

- As the number of infectious diseases and their ability to spread quickly increases, insufficient effort will be made to detect their outbreak early and precisely enough in the United States and Russia to ascertain whether the epidemic was natural or the result of terrorist or state action, and to limit the harm that might otherwise be done to the general populations.

- Several factors will only increase the risks of nuclear theft and terrorism: the huge and growing stockpiles of nuclear weapons materials in the United States and Russia from dismantled weapons; the significant remaining uncertainties regarding these and civilian holdings (particularly in Russia); and the proposed conversion of surplus weapons plutonium into reactor fuel.

- Lacking the ability or interest to create private sector employment opportunities, Russia will again find its best and brightest drawn to the security and prestige of working in Russia's weapons-related facilities and government, thereby becoming further estranged from the West and indifferent or hostile to U.S. and allied proliferation concerns.

None of these longer-term concerns is yet a major focus of existing U.S.-Russian cooperative threat reduction programs. Nor has much been done to explain how currently supported programs will be able to meet the growing list of congressional effectiveness criteria, including these programs' ultimate defederalization.

The report that follows, which is the result of over 2 years of planning, some 13 commissioned studies, and the

participation of over 30 Russian experts, attempts to address each of these issues.

What makes this report different from other studies of U.S.-Russian nonproliferation cooperation is its use of competitive strategies analysis. Rather than focusing merely on current events, this methodology encouraged the study's participants to concentrate on the security challenges and opportunities the United States and Russia would face over the next 10 to 20 years. Use of competitive strategies analysis also forced the study's working groups to consider how **differences** in U.S. and Russian security aims and strategies might help guide future nonproliferation cooperation. Finally, rather than focusing on ways to shore up the weaknesses in existing cooperative threat reduction efforts, the use of competitive strategies helped the working groups to determine how U.S. and Russian strengths might be pitted against enduring weaknesses to suggest new, sounder paths of nonproliferation cooperation. An additional objective of this study was to suggest leveraged cooperative efforts that could be paid for within existing or significantly **reduced** levels of funding.

The study's participants and commentators suggested four specific undertakings:

- **First, the United States and Russia should work immediately toward the joint deployment of a health monitoring system to detect outbreaks of infectious disease.** The deployment of such a system would serve two purposes. First, it would permit timely protective actions to be taken in the event of biological agent attacks against civil or military populations. In this regard, establishing such a system would help support the objectives of the Biological Weapons Convention (BWC). Also, expanding such a monitoring system to include other nations is a task that former Russian biological weapons-related experts might undertake as a peaceful alternative enterprise. Second, joint deployment could help the United States and

Russia determine how best to address Russia's own growing health concerns, which if not properly addressed could jeopardize not only Russia's future vitality, but the health of nations that have routine contact with Russia.

- **Second, the United States and Russia should coordinate plans to have Russia receive U.S.-origin spent reactor fuel from other nations for a fee, for getting a more accurate inventory of Russia's nuclear weapons and nuclear weapons-usable materials holdings, and for jointly forswearing the chemical separation of plutonium for commercial or nuclear weapons purposes.** U.S. and Russian officials have already discussed how lucrative commerce in spent fuel storage (worth as much as 15 billion dollars over the next decade) could be used to help pay for critical Nunn-Lugar programs. This business, however, would require Washington's approval since it would mainly involve nuclear fuel of U.S. origin. Before granting such permission, the United States should secure Russia's cooperation to get a more accurate inventory of Russia's existing civil and military nuclear holdings. Securing and sharing such inventory data are essential: without it, neither Russia nor the United States will be able to learn how well their other nuclear cooperative threat reduction efforts are reducing the risk of illicit proliferation and nuclear theft. In addition, the United States should condition such commerce on Russia's willingness to reduce the flows of nuclear weapons-usable materials (as the United States has already done) by forswearing chemical separation of plutonium for civilian or nuclear weapons purposes.

- **Third, the United States, the European Union, and Russia need to cooperate much more extensively to increase the quality and number of student exchanges.** If U.S.-Russian cooperative threat reduction efforts are to lead to true lasting defense conversion, it is essential that Russia's most talented youth not be drawn to

work in Russia's military-industrial-research sectors simply because no better alternatives exist. A recent poll of Russian university students indicates that over a third would consider working in closed nuclear cities, while over 60 percent of the very best students would choose to work in one of Russia's state enterprises. This must change. To accomplish this, however, requires awareness among Russia's youth of civilian private sector alternatives not yet present in Russia. This can most easily be secured through exchanges with the United States and Europe where such alternatives are common. Unfortunately, to date the numbers of such exchanges have been far, far too low.

• **Finally, to the extent possible, those cooperative nonproliferation programs that cannot be privatized should be paired with transparent cooperative defense conversion programs that can.** The idea here is initially to help pay for cooperative programs that cannot be privatized with profits from those that can. In time, this approach would also give Russians and Americans a profit motive to pressure their governments to complete those cooperative threat reduction programs that cannot make money. Finally, this approach might help reduce concerns that monies invested in or raised by cooperative defense conversion projects might indirectly end up supporting those Russian weapon-related activities that the projects are supposed to replace.

Each of these recommendations, along with the analysis they were based upon, is presented below.

Key Assumptions.

In assessing what should guide U.S.-Russian nonproliferation cooperation efforts over the next 2 decades, the study's working groups tried first to understand in what relevant ways Russia's foreign policy and military views might differ from those of the United States. This analysis produced three major findings:

• **Russia's foreign policy agenda and non-proliferation concerns in the mid- and short-term are likely to be very different from those of the United States.** Whereas the United States will continue to want to maintain global order, Russia will see its ability to influence events in its near abroad (i.e., Central Asia, the Balkans, and the Baltic states) as being critical to maintaining national authority over its own diverse populations and territories. Thus Russia (particularly its military) is very likely to remain sensitive to expansion of the North Atlantic Treaty Organization (NATO). In addition, Moscow will see strategic cooperation and good relations with Iran, Iraq, India, and China as being in its short- and mid-term interest to help it maintain influence over Russia's relatively unstable periphery.

• **Russia's long-term foreign policy and non-proliferation concerns, though, are less likely to clash with those of the United States.** There are two reasons why. First, over the next 2 decades, Russia by itself will be unable to compete economically (and thus militarily) with China. It could subordinate itself in some loose alliance with China against the United States and its European and Asian allies. Or Russia could cooperate more closely with the West to gain the economic skills and capital to become a more vital nation in its own right. Second, Moscow will naturally have a good deal to lose if states on its periphery (e.g., Iraq and Iran) increase their military might to a point where the United States or its allies are compelled to intervene.

• **Russia only partially shares Washington's views regarding nuclear weapons and nuclear power.** While the Russian military is willing to reduce the number of strategic weapons Russia deploys, it sees continued deployment and enhancement of its theater nuclear weapons systems as being critical to shore up inadequacies in Russia's conventional forces. With regard to civilian nuclear power, Russia is eager to save (and expand)

as much of its current nuclear infrastructure as possible and believes it can do so through nuclear exports to such nations as India and Iran (nations to which the United States has blocked U.S. nuclear exports on nonproliferation grounds). Russia also hopes to make money providing spent fuel storage and reprocessing services to other nations even though the United States has been uneasy about both the further expansion of civil reprocessing and increased international commerce in nuclear weapons-usable fuels.

In addition to identifying these differences, the study's working groups used competitive strategies analysis to pinpoint U.S. and Russian strengths and weaknesses relevant to devising and guiding future cooperative nonproliferation initiatives. This gave rise to the following determinations:

- **The United States should continue to tie U.S. cooperation with Russia to the latter's ending its missile and nuclear assistance to Iran but recognize that doing so may no longer be as rewarding as it once might have been.** As already noted, Iran has received so much nuclear and missile assistance over the last decade that some analysts believe that cutting off all further Russian assistance now may have only a negligible impact on Iran's ability to deploy long-range nuclear systems. This doesn't mean that the United States should stop calling on Moscow to end all assistance. The United States should indeed continue to help slow these programs down. What Washington must recognize, however, is that the days when demanding this might keep Iran from achieving ballistic or nuclear capability may be past. Indeed, Iran is now so close to development of these capabilities it may be difficult for the United States and its allies to know for sure whether Russia had cut off all further assistance **even if it had**. In any case, Russia's good behavior now would be unlikely to prevent the current regime in Iran from developing long-range nuclear systems. Thus it is important that if the United States or Russia

proposes any major new forms of nonproliferation cooperation, they be tied to some more ambitious mutual nonproliferation goal than preventing Iran from acquiring the means to deploy long-range nuclear arms.

- **The most promising areas for future non-proliferation cooperation are most likely to be in the health and nuclear waste management fields.** In these two areas, U.S. and Russian strengths and weaknesses complement one another. In the United States, high quality medical services are readily available but America's public health institutions have fallen into disuse. In contrast, the health and vitality of Russia's population are shaky and projected to get worse. Russia, on the other hand, still has an extensive public health system left over from the Soviet era, but it is poorly equipped. As for Russia's most advanced medical and pharmaceutical research institutions, too many in the past have been connected with biological and chemical weapons work. When one turns to nuclear power, the U.S. Government is more interested in maintaining its nuclear infrastructure than expanding it. Russia, on the other hand, believes it must expand its nuclear exports simply to keep its nuclear industry alive. With Russia selling its reactors to a shrinking market for a fraction of the prices charged by its Western competition, though, it is unclear how profitable such business will be. This explains Russia's interest in getting into the nuclear waste management business, which is potentially worth many billions of dollars and for which there clearly is a market. Indeed, Western demand for spent fuel storage services is quite high. What Russia lacks, however, is the enabling authority needed to receive a good portion of the world's spent fuel, which, because of its U.S. origin, cannot be moved without Washington's consent.

- **Future efforts to convert Russian strategic weapons expertise and assets into profitable civilian enterprises will have to rely less on U.S. taxpayer largesse and reflect less optimism concerning the**

Russians' near-term drive or ability to create private businesses. Although Nunn-Lugar programs remain popular, draft legislation this fall made it clear that the U.S. House of Representatives expects the program's defense conversion projects to be defederalized within 4 years. Implicit in this demand is the expectation that after 4 years of support, defense conversion projects should be self-sustaining private enterprises. The problem here is the U.S.-Russian track record: the United States has too often pushed projects the Russians have not fully supported, while U.S. and Russian government officials have too frequently promoted projects that lacked serious business plans or sound management. The moral of this experience is basic: if entrepreneurial forces are to be harnessed in Russia to spur defense conversion, it will not be the result of U.S. Government decisions or management. Instead, it will require major reform of Russia's tax, legal, and financial systems to make them far friendlier to the creation of small and medium private enterprises than they are today. In addition, it will require the creation of many more able Russian entrepreneurial managers (particularly in the high technology sectors) to draw Russians (and Russia) away from their historical attraction to large, command-style enterprises run by the state. As a practical matter, such structural changes will take time and will require selective mutual exposure between the right Russians and the appropriate Americans and Europeans.

Additional Analysis and Recommendations.

In keeping with this guidance and the previously noted findings, the study's working groups made the following recommendations:

First, the United States and Russia should work immediately toward the joint deployment of a health monitoring system to detect outbreaks of infectious disease. The objects of deploying such a system would be to enhance enforcement of the BWC, improve the health of

Russia's citizens, and assure early detection in the United States and Russia of the **natural** spread of deadly infectious diseases and of bioterrorist attacks.

The George W. Bush administration recently requested that the members of the BWC support the World Health Organization's health surveillance program. The World Health Organization has been working to promote international monitoring of infectious disease for years. The problem is that, so far, it has only been able to get its membership to monitor and report on three sicknesses—yellow fever, plague, and cholera. The reporting, moreover, is generally limited to information regarding **confirmed** outbreaks, rather than the type of preliminary data needed to contain such outbreaks in a timely fashion.

This sort of reporting conservatism may make sense to an underdeveloped nation fearful of losing tourism dollars, but it makes no sense if you need early warning of the possible outbreak of a **vast array** of infectious diseases **before** they spread out of control.

The U.S. Government understands this. That is why following the anthrax letter attacks of the fall of 2001, it supported the expansion of an inexpensive and proven reporting system already working in New Mexico known as the Rapid Syndrome Validation Project (RSVP). RSVP uses computers, touch-screen entry, and the Internet to enable doctors to make speedy reports to public health authorities when they encounter patients who have a particular set of symptoms. A report can be filed in less than a minute. The system assumes no prior knowledge of exotic diseases and covers over 90 percent of the diseases a biological weapons attack might inflict. The program is also cheap. A basic U.S. national system of 1,000 stations could be set up for approximately \$5 million; a crude global system of 10,000 reporting stations for approximately \$20 million.

The immediate benefit of deploying this system beyond U.S. borders would be to improve public health reporting internationally. Certainly, anything the United States or

others do in this respect could support the health surveillance efforts of the World Health Organization. The long-term payoff would be to establish a baseline from which to detect unusual events, such as bioterrorist attacks or epidemics. These could then be identified early enough to allow actions to be taken to prevent harm from coming to any nation's general population.

In Russia's case, the benefits of deploying such a system, though, would be more substantial. Russia's population is not healthy, and it is projected to get much, much sicker. Indeed, Putin highlighted this point last year when he cited Russia's declining population (a decrease of 750,000 people per year) as one of the nation's most serious problems. Analysis commissioned by this study forecasts a Russian population decline by approximately 50 million (i.e., over 30 percent) over the next half-century. The most important cause for this demographic decline is the deteriorating health of Russia's population. The incidence of HIV/AIDS, tuberculosis, hepatitis C and B, and syphilis are all on the rise. This has had and will continue to have a major impact on the health of all sectors of Russia's population.

To reverse these trends, it is critical that Russia's public health authorities be able to detect and monitor new outbreaks of infectious diseases early and precisely enough to locate their sources and take appropriate measures before they further harm Russia's population. This conclusion is one now becoming apparent to both U.S. and Russian officials. In fact, late in the summer of 2001, after this study's working groups recommended joint deployment of RSVP, several working group participants contacted senior U.S. and Russian officials who evinced interest in backing such an undertaking. One idea currently being considered is using Russian biological research institute scientists to help deploy the system in Russia. Assuming they gain the experience they need, these experts could then provide their services in deploying RSVP to other nations for a fee. The profits from this activity eventually could be

used to help support the operation of RSVP within Russia itself.

Second, the United States and Russia should coordinate plans to have Russia receive U.S.-origin spent reactor fuel from other nations for a fee, while getting a more accurate inventory of Russia's nuclear weapons and nuclear weapons-usable materials holdings and jointly forswearing the chemical separation of plutonium for commercial or military purposes.

In the late 1990s, a private group of U.S. representatives from the environmental, business, and national security communities known as the Nonproliferation Trust, Inc., proposed to store foreign (i.e., non-U.S., non-Russian) spent fuel in Russia and use the revenues thus raised for a variety of cooperative threat reduction programs and other causes.

Russia's Duma and Russia's nuclear industrial organization, Minatom, have both shown considerable interest in this proposal. So have German and U.S. officials. Under the scheme, the United States would have to give Russia permission to receive U.S.-origin spent reactor fuel from Europe, Taiwan, and South Korea. These countries' utilities would then pay Minatom a fee for storing the spent fuel in dry storage casks for 40 years.

Assuming a proper customer base, this business should generate as much as 15 billion dollars in revenue. Of this figure, approximately 3 to 4 billion dollars would be needed to transport and store the spent fuel. This would leave over 11 billion dollars that could be used to support a variety of Nunn-Lugar programs and other causes. The Nonproliferation Trust has already proposed to use this money to provide for Russian fissile material security (1.5 billion dollars), construction of a Russian spent fuel repository (2 billion dollars), environmental clean-up (3 billion dollars), salaries for Minatom workers (1.8 billion dollars), and humanitarian causes and pensions (2 billion

dollars). Each of these activities and their funding would be overseen and audited by a corporate board that would include prominent U.S. national security and environmental experts as well as Russians.

Clearly, implementing this proposal could go a long way toward paying for some of the more expensive critical cooperative threat reduction efforts. In addition, these monies could keep a significant portion of Minatom's staff employed and do so **without** raising proliferation risks.

This last point, however, is not assured. Minatom would like to get into the business of chemically separating plutonium from spent reactor fuel and using it to make mixed oxide uranium-plutonium fuels for power reactor use. Such a business is so unprofitable, though, that no private investor has offered to fund it. More important, such fuel services would initiate the transit of thousands of nuclear weapons' worth of nuclear weapons-usable materials all over Russia and much of the world. Certainly, if the United States and Russia are serious about reducing the threat of nuclear terrorism and theft, this is not a business their cooperative threat reduction efforts should promote. At a minimum, none of the monies that might be raised through implementation of the Nonproliferation Trust idea should help finance such activities.

But there is more cause for concern. Russia is still producing nuclear weapons-usable materials. Compounding this nuclear threat is the dearth of knowledge regarding Russia's current nuclear weapons material holdings. Although Russia has declared 50 tons of weapons-grade plutonium to be in surplus, very little is known about Russia's total military inventory of nuclear weapons materials. Thus, in 1999, senior U.S. Department of Energy officials privately conceded that the United States knew only to within 30 percent (plus or minus) what this figure might be. That's a big number, one equivalent to approximately 23,000 advanced thermonuclear weapons' worth of material, i.e., nearly four times the amount of

material contained in all of the strategic nuclear warheads the United States has deployed.

Again, if the United States and Russia are serious about reducing the threat of nuclear terrorism, nuclear theft, and nuclear proliferation generally, these uncertainties about Russia's nuclear holdings are unacceptable. Certainly, it makes no sense to pay for and focus so much on the storage and disposition of 50 tons of surplus nuclear weapons material if well over ten times as much may exist unaccounted for. Just as implementation of the Nonproliferation Trust proposal should be conditioned upon Russia's offering a pledge to forgo nuclear weapons or civilian reprocessing, implementation should not proceed unless the United States and Russia first reach some understanding about what their nuclear weapons materials holdings actually are.

This understanding ought to be more than an oral agreement. Specifically, implementation of the Nonproliferation Trust proposal should be tied to clarifying and reducing existing uncertainties. This means that both the United States and Russia will have to be more forthcoming about sharing nuclear inventory information and opening up facilities to mutual or international inspection than they have been to date. These conditions are a price worth paying. Indeed, the potential financial and nonproliferation benefits of proceeding with the Nonproliferation Trust proposal are too great not to insist that these conditions be met.

Third, the United States, the European Union, and Russia need to cooperate much more extensively to increase the quality and number of student exchanges.

As already noted, many of Russia's best and brightest university students find the prospect of working in the government's military research industrial complex more attractive than facing the obstacles and risks associated with seeking private employment or starting private

civilian businesses of their own. Clearly, no lasting defense conversion can occur so long as this is the case. These Russian students' current attraction to working for state enterprises is partly due to the impressive number of legal and financial obstacles erected by the state against private entrepreneurs. They also are aware of the risks and costs imposed on such ventures by state-supported corruption that preys upon the profitable. By contrast, employment in state enterprises seems to offer a far more certain and attractive future. Wages may be low, but the social benefits of such employment—e.g., free housing, access to quality health care and education, daycare, and subsidized food, etc.—are still substantial.

Finally, and perhaps most important, most Russians have developed a work ethic that is ill-suited for private enterprise. The top-down directive style of management, so common during the Soviet years, is still popular and all too effective in stifling the kind of initiative and responsibility private businesses require of their employees. Also, there is the matter of Russian tolerance of and cultural sympathy for cheating, which makes accountability and sound accounting—both essential to any private enterprise—nearly impossible.

These and other anti-business cultural traits, of course, are learned and can be undone. To do so, however, Russia's best and brightest youth need relevant, first-hand exposure to the West. Conversely, those American and European students most interested in Russia need to understand how Western business practices, the rule of law, management techniques, etc., can be introduced into Russia without being stymied by ingrained cultural norms. This dictates vigorous student and youth leadership exchanges.

The numbers of Russian students (high school students, undergraduates, and post-graduates) currently enrolled each year in the United States (over 5,000), the United Kingdom (approximately 2,500), Germany (approximately 900), and Australia (approximately 800) are not

insignificant. Still, they are paltry in comparison to the number of visiting Chinese students, who last year exceeded 100,000 in the United States alone. In fact, the per-capita rate of visiting Russian students is far below that of many lesser nations. Also, only a small percentage of advanced Russian students that attend U.S. schools and return to Russia get an opportunity to work in serious career-related jobs while they are in the United States. More important, roughly 85 percent of these visiting Russian students are 19 years or older, i.e., well beyond the age of adolescence when one's social habits are still very much being formed.

There are a variety of reasons why the number of Russian students enrolled in universities in Europe and the United States is so low, and why the number of Russian high school students enrolled in these countries is lower still. Russian students must first learn English (or German) to make their visits worthwhile. It has often been difficult for Russians to get Russian academic credit for the work they do overseas (particularly if they attend less rigorous American high schools). Outside Moscow, Russian students have less knowledge of the benefits of becoming an exchange student.

But perhaps the most important impediment to increasing the number of Russian high school students visiting the West is the appalling insufficiency of U.S.-Russian student exchange programs. In 1992 when the United States Congress passed the "Freedom Support Act" for Russia, it authorized 20 million dollars to fund what it hoped would be over 15,000 U.S.-Russian high school exchange students a year. In addition, it provided another 30 million dollars to fund a similar number of undergraduate and graduate exchanges. After nearly a decade of promoting these programs, though, the number of U.S.-Russian exchange students is still woefully shy of these targets.

In 1999, for example, there were only some 5,300 Russian exchange students (of all ages) enrolled in the United States, and fewer than 500 American exchange students (of all ages) enrolled in Russian schools and universities. Almost all of the American students and a large majority of the Russian students (85 percent or more) were over 19 years of age.

Clearly, the numbers here are far too small. Among the key obstacles to increasing the number of American students enrolled in Russian schools and universities is that not enough American students are sufficiently fluent in Russian, and that parents are rightfully concerned about their children's health and well-being while in Russia. As a result, there are likely to be more American undergraduate and graduate students interested and equipped to visit Russia than there will be high school students. If the number of American and European student visits to Russia were higher, the number of Russian visits to Europe and the United States would increase as a matter of course.

The question is how to make this happen. The study's participants had several ideas:

- Expanding current European Union and U.S.-funded student exchange programs to support Russian exchanges with the United States, European Union nations, and Australia. The idea here would be to encourage Russian exchanges with the United States and nations friendly to the United States rather than the United States alone.
- Creating a joint U.S.-European Union-Russian commission that would work to identify and eliminate as many of the current obstacles as possible to increasing Russian, European, and U.S. student exchanges.
- Treating American high school, undergraduate, and graduate exchange students as a single category so as to increase the numbers from which Russian high school exchange students might be paired.

- Creating more mentoring and internship programs for Russian exchange students visiting Europe and the United States so that their academic work in their chosen careers would be complemented by exposure to the Western work ethic prevalent in the appropriate professions. Such programs, in turn, could be created for U.S. and European exchange students visiting Russia as well. Certainly, these and other ideas need to be examined on a priority basis.

Finally, to the extent possible, those cooperative nonproliferation programs that cannot be privatized should be paired with transparent cooperative defense conversion programs that can.

As already noted, Congress has increased its scrutiny over the defense conversion projects that the Nunn-Lugar program funds. As a result of this oversight, Congress has generated an impressive list of desirable attributes for these projects. Just a sampling drawn from the most prominent analyses demonstrates how detailed the list has become. These criteria include making sure that the projects:

- avoid enhancing Russian strategic weapons capabilities;
- avoid the reinvestment of project profits and startup capital in weapons institutes;
- offer work that draws Russian weapons workers as far away from the activities of their weapons or nuclear institutes as possible;
- operate with transparent management and accounting procedures;
- create jobs for weapon scientists rather than employment for others at the weapons sites (e.g., spending on day care centers at the weapons institutes);

- draw future generations away from work in the military complex;
- encourage private sector employment as much as possible over public sector employment;
- promote nonproliferation results, e.g., quantifiable weapons reductions, increased monitoring of adherence to existing nonproliferation agreements, reduction in the threat of strategic weapons capabilities leaking to others outside of Russia, reduction of the chances for terrorist seizures, etc.;
- are designed to eventually be sustainable without congressional funding; and,
- have clear objectives and deadlines for completion.

It would be desirable, of course, if all U.S.-Russian cooperative threat reduction efforts met all of these requirements. As a practical matter, however, it is unlikely that any project has or ever could. Still, failing to meet these criteria could defeat the purpose of the projects. Certainly, no one in Congress wants to fund defense conversion efforts that might help Russia to sustain its weapons capabilities. Nor should the United States and Russia cooperate on programs that can never get done or that produce negligible nonproliferation benefits.

These realizations rightly troubled several of this study's working group members who, after several weeks of additional consideration, hit upon the idea of pairing. They recognized that many of the Nunn-Lugar program projects could operate only if they receive congressional funding, while others could not be initiated without such money. They also recognized, however, that frequent U.S. and Russian government support and involvement in these projects reduce the likelihood that they will ever make it commercially on their own.

There are, of course, exceptions. One example of a defense conversion effort that became self-sustaining recently is a small software company that was set up in the early 1990s to capitalize on the mathematics expertise of seven scientists from the All-Russian Research Institute in Sarov. Since then, the firm has created permanent civilian employment for about 100 former weapon scientists. These scientists now make three times what they made in the weapons institutes.

As significant as this success might be, however, it has done nothing to support the other cooperative threat reduction efforts that cannot make money. Could such profitable endeavors that are capitalized with U.S. funding be paired with necessary but unprofitable cooperative threat projects? This was the question several working group members raised. What inspired their question was the Nonproliferation Trust's business concept whereby profits from one activity—the storage of spent reactor fuel—would go to support other cooperative threat reduction activities that are incapable of generating revenue. It was this proposal that also suggested this report's recommended approach to deploying RSVP—getting the Russians to be the purveyors of health monitoring to other nations and using the monies raised to help maintain RSVP within Russia.

Members of this study's working groups learned from inquiries in the fall of 2001 that although such pairing has not yet been used in U.S.-Russian cooperative threat reduction efforts, it was attractive to U.S. officials on at least three counts:

- First, it could help defray the costs to the United States taxpayer of supporting cooperative threat reduction efforts generally, i.e., help defederalize them;
- Second, it would give both Russian and American officials an even greater incentive to develop defense

conversion programs that could succeed commercially on their own;

- Third, it would give both Russian and American entrepreneurs a profit motive to ensure that their governments concluded (with a date certain) the unprofitable cooperative threat reduction programs that their business profits were being used to support.

The apparent advantages of this approach, of course, have to be tempered by reality: not all cooperative threat reduction programs will be profitable, nor will those that are be able to pay for all those that are not. That said, to the extent possible, this pairing approach should be tried and applied.

CHAPTER 2

THE FOUNDATIONS OF RUSSIAN STRATEGIC POWER AND CAPABILITIES

Stephen J. Blank

INTRODUCTION

Will the availability and quality of Russian strategic capabilities increase or decline over the next 2 decades and, whichever result, why? Conventional wisdom has it that Russia's strategic capabilities will either grow or remain intolerably high over the next 2 decades, yet there are some reasons to believe that the human expertise and capital assets related to strategic weapons may decline. Given current economic trends, Russia's military forces and production surge capabilities should be able to approach the quality and quantity enjoyed by the Soviets during the late 1980s. Moscow, however, would like to modernize its nuclear forces, dual-use information systems, and advanced conventional weapons and also invest in new weapon systems such as direct energy weapons, lasers, microwave radiation emitters, particle beam generators, and mass plasma weapons. The problem is how to pay for this. Certainly, Russia's military budget will not be able to carry these programs, even if Russian President Vladimir Putin's recently proposed economic and defense reforms are successful.¹ Thus the only way Russia can achieve its military ambitions is to secure and maintain substantial new sources of foreign financial investment and technical cooperation.

This chapter has three sections. The first describes how the Russian military plans to modernize its existing nuclear forces and acquire new strategic weapons capabilities by increasing central control over the defense industry and expanding Russia's influence in the former Soviet Union. The second section identifies the two major obstacles to that plan—the economic crisis and the steady decline in the numbers of Russian scientists. Section three illustrates that the Russian elite understand these problems and are trying to overcome them by relying on arms sales, space launches, the Cooperative Threat Reduction Program (CTR), and other foreign capital flows to fund Russia's acquisition of strategic capabilities. This chapter concludes that Russia's current path can only lead to failure, and how far they progress is dependent on how far other countries are willing to finance them.

WHAT STRATEGIC CAPABILITIES RUSSIA WANTS AND HOW IT PLANS TO ACQUIRE THEM

Russia's Wish List.

To understand what strategic weapons capabilities the Russian military wants to acquire over the next 20 years, we must first understand what the Russian military defines as strategic. When one thinks of strategic weapons, the first thing that comes to mind is submarine- or land-launched long-range ballistic missiles armed with nuclear weapons. But the writings of many Russian observers plus evidence from Russian exercises such as *ZAPAD-99* indicate that, in the Russian view, tactical nuclear weapons (TNW) can do strategic duty by bringing about Russian control of any intra-war escalation, thus forcing the North Atlantic Treaty Organization (NATO) to negotiate on the basis of the status quo ante and cease military operations. Since Kosovo, the volume of official writing endorsing heavier reliance on such nuclear weapons has only increased.²

Similarly, many leading Russian military thinkers argue that information weapons and information warfare

(IW) can achieve strategic outcomes. They see IW as a strategic threat comparable to nuclear weapons in their functional outcome.³ Here IW and/or various forms of electromagnetic warfare in general become a potentially self-sufficient operation in their own right. For example, retired General M. A. Gareyev, President of the Academy of Military Sciences and the dean of Russian military thought, believes IW capabilities could by themselves achieve a definite strategic goal.

Future wars could be fought without even resorting to force, purely by informational and electronic means. In fact, the cataclysm culminating in the collapse of the Soviet empire and the Soviet Union illustrates that states and coalitions can disintegrate as a result of confrontation on the international arena without the direct application of force.⁴

Another nonnuclear capability that could have strategic impact is advanced conventional weapons (ACW). These, according to many Russian thinkers, if targeted on key strategic targets like command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems, nuclear power plants, or nuclear weapons silos can, by purely conventional means, effectuate decisive strategic outcomes. Consequently, such ACW attacks upon conventional targets might justify a first-strike nuclear response.⁵ That guidance was expanded to lower the threshold for nuclear use and apparently remains operative in the 2000 defense doctrine, largely due to NATO's campaign in Kosovo.⁶

Russian military thinkers also believe that integrated space technologies relevant to projecting power for naval and land operations constitute a strategic weapons capability that Russia must acquire.⁷ These writers optimistically emphasize that Russian submarines and aircraft can already launch global monitoring satellites. Space will become the high ground whose possession offers potentially decisive strategic benefits and advantages. They

also point out that recent technological trends plus the revenues accruing to Russia from projects like the International Space Station (ISS) indicate that funding for at least some of those capabilities is available **as long as Russia participates in foreign operations like the ISS.**⁸ On the other hand, these writers are concerned that U.S. missile defenses will trigger an arms race whereby control of space and thus anti-space weapons from nonspace platforms, e.g., land-based anti-satellite weapons (ASATs), become weapons endowed with potential strategic significance.

How Russian Military Planners Intend to Acquire Capabilities.

Although a new cycle of reforms has just been announced in military policy, we cannot categorically state that they can or will be implemented or that they will seriously address Russia's basic strategic dilemmas. Indeed, for the last 3 or 4 years, it has been almost impossible to discern any consistently implemented threat assessment and defense policy. As a reporter for *Segodnya* observed in August 2000,

The blatant incompatibility of the defense minister and the Chief of the General Staff confirms that we have no united military leadership and that none of the key defense documents (military doctrine, national security concept) has any practical value, because they do not express a consolidated view on military organizational development.⁹

What is more important to understanding Russia's military future, however, is not how coherent its military planning might be, but that it no longer has the means to unilaterally provide for its own defense. In fact, it cannot support its military industrial structure without large-scale foreign subsidies and transfers. In this sense, Russian security depends quite literally on the kindness of strangers. Whether these transfers originate in arms sales, foreign subsidies through programs like the Nunn-Lugar CTR, foreign fees for space launches using Russian and Soviet missiles, or joint production with foreign producers,

they alone allow Moscow to supplement its budgeted and extra-budgetary defense programs and maintain the current defense economy.

The paucity of available domestic resources and the absence of a state capacity rule out a Stalinist-like autarkic defense sector. Given available resources, Russia can only be “a great power” or global power on the basis of other states’ sufferance. Therefore, to compete militarily and politically Russia must find allies and friends on each individual issue in international security.¹⁰ This search for alliances is as true for defense economic policy, weapons sales in Asia and Europe, and the search for joint projects in aerospace and defense procurement contracts with the West, as it is for foreign and national security policy.

Russia therefore openly seeks to generate maximum foreign collaboration to develop its strategic capabilities. Its objectives are transparent. It aims to win contracts to create a basis to solidify its position abroad while creating a basis for joint production of conventional or strategic systems. Moscow also seeks political leverage within those areas and access to higher levels of technological capability, particularly in Western Europe, through either the rather nebulous proposal for a “nonstrategic” European-Russian missile defense or joint ventures with European defense firms.¹¹

Russia also pursues an exclusive sphere of influence within Confederation of Independent States (CIS) economies through defense-economic integration, e.g., with Ukraine, Belarus, and Kyrgyzstan. Reintegrating the former Soviet defense industrial network offers Moscow access to capabilities that had been lost with the breakup of the Soviet Union. Foreign subsidy and arms sales programs also let the government circumvent unwelcome scrutiny of the true extent of military spending and the defense economy. That scrutiny would likely force further retrenchment and result in less foreign subsidization in an effort to make the government accountable to the people

and force it to live within its real means. Earlier trends to reduce the opacity of the budget to the Duma have been reversed, and Putin's recent call to reduce the budget approval process to a formality and establish an authoritarian police state in Russia have become quite evident.¹²

The excessively large defense industrial complex testifies to the authorities' failure to properly align Russia's threat assessment with available strategic resources. Retention of this excessively large sector demonstrates the continuing failure of defense and economic reform, a continuing flight from strategic reality that jeopardizes the military and any hope for a true democratic future. Meanwhile, its perpetuation ensures Russia's continuing poverty and isolation abroad despite the terrifying socio-economic challenges confronting it. Speaking about prospective nuclear forces, Dr. Nikolai Sokov observed that,

Essentially, today only economic constraints continue to operate, and they appear a relatively weak variable. There is strong belief that a stronger government which is oriented toward national interest rather than more universal goals of democracy, market, and integration into the international community, could generate economic growth and yield resources, including for defense spending. Whether this belief is correct or not does not matter much under the current conditions. The powerful mayor of Moscow, Yuri Luzhkov, has already demonstrated that there is at least a theoretical possibility to combine market with an authoritarian regime and that such a combination could generate money. The fact that he was able to spend some money from the city budget to finance arms acquisition serves as proof in the eyes of the military leadership and the defense industry that economic constraints are not insurmountable.¹³

This neo-Soviet approach also suggests that arms sales are surrogates for reform in order to keep this system afloat. Putin's defense of this neo-Soviet outlook and policy implied as much:

The unique peculiarity of military-technical cooperation is that it lies where several important areas meet international activities in general, military-political work both inside the country and abroad, and trade and economy. . . . Judging from the volumes that military-technical

cooperation gives to the country's budget, this is one of the most important areas for us. . . . It is common knowledge that the export of weapons and military hardware earns the budget considerable sums in currency. These means allow us to maintain cooperation between science and industry in the country, preserve the scientific and industrial potential, and keep personnel at defense enterprises.¹⁴

Although General Thomas Wilson, Director of the U.S. Defense Intelligence Agency, testified that, absent a total collapse of state power, he cannot imagine a non-nuclear Russia in 2015, several Russian and even foreign analysts fear just such a collapse.¹⁵ Yet Russia still spends far too much on its armed forces, and the return on the investment appears to be quite low relative to other peer competitors. One thing is thus clear: if Russia attempts to acquire the strategic capabilities it wants, it will need help from other nations.

THE OBSTACLES TO RUSSIA'S REALIZING ITS STRATEGIC WEAPONS ACQUISITION AMBITIONS

Russia's Lack of Money.

Not only is economic growth slowing amidst widespread predictions of a crunch by or in 2003 as foreign debt rises, but capital outflow remains an estimated \$20 billion a year, indicating a continuing lack of domestic confidence in Russia's prospects. That outflow and lack of confidence severely impede efforts toward civilian or military scientific and technological progress through 2020. The economy's high-tech component is severely stressed from the lack of investment and accelerating decline since the time of former Soviet First Secretary Nikita Khrushchev. There also are serious dysfunctional trends throughout the high-tech and electronic sectors of civilian and defense industry. Finally, beyond Russian science's structural defects, the state, too strong to permit autonomous market-driven change in defense industry and too weak to implement effective statist controls, has increased its presence in the defense industry and will likely be overwhelmed by its incapacity to make its

policies work. Absent a coherent growth strategy, plus military and defense spending reforms, Russia cannot produce the desired increases in quality, quantity, and availability of all forms of military power.

Apart from its heavy defense burden, Russia has \$48 billion in foreign debts coming due between now and 2003. Moreover, it must spend enormous sums to retrieve the health, ecology, and demographic potential of the country in order to be a major regional power, let alone a global player.

Putin understands some of this dilemma and recently observed that the foreign debt burden makes it unclear whether Russia can find “enough money for education, defense, health care, space, and science under such gloomy conditions.”¹⁶ However, those are precisely the areas that must be built up under conditions of fiscal and capital shortage in an economy, 40 percent of whose state revenues apparently come from “rents” on oil and gas exports, even as production of those commodities declines.¹⁷ Nor are the resources to reverse that decline to be available soon. The cumulative decline of the infrastructure and capital stock, as well as the shortage of domestic and foreign investment capital, cripples efforts to develop an autonomous civilian high-tech sector.¹⁸ Though Russia largely retains the Soviet capital stock, it is usable only autarkically, not as part of a world economy despite favorable exchange rates since 1998. Therefore Russian exports remain uncompetitive except for energy and some defense sectors. Since this lopsided, even neo-colonial structure of trade goes back years, it is not surprising that the defense industry and its spokesmen quickly realized that, in post-Soviet conditions, arms exports were their only salvation as well as an obstacle to the true marketization of the economy which would force them to reform and become even more competitive.¹⁹

Russia's Shrinking Pool of Scientifically Trained Personnel.

In addition to not having enough money to develop the strategic weapons capabilities it wants, Russia's pool of scientifically trained personnel is shrinking. The decades-long decline, lack of opportunity, and paucity of investment have put Russian science on the brink of a catastrophe. As of February 2001, about 4,000 organizations deal with scientific research but obtain only about 16 percent of the financing available in 1990. Russia spends on researchers 4 percent of other developed nations' expenditures. The average life expectancy for a Russian male is 59. The average age of a Russian researcher is approaching 60, and few young people join scientific organizations because of the poor pay. Such younger people make up only 11 percent of those engaged in fundamental scientific research.²⁰

Meanwhile a brain drain steadily erodes Russian science. This drain takes many forms: 75 percent of world-class mathematicians and 50 percent of physicists have emigrated; many scientists now work on foreign contracts or for foreign-owned firms; many sell patents and designs, including those for sophisticated military systems, abroad. Indeed, this huge outflow and diversion of scientists threaten Russia's security and independence. In all, 85 percent of Russian doctors of science are working abroad.²¹ The number of scientists as of 1997 had fallen to 1.3 million, and by 2000 to 910,000, with at least 10 percent of those actively seeking to go abroad. Although Russian scientists, especially programmers, are in demand abroad, their activity in Russia is limited by obstructions facing business and science which must be removed for science to flourish.²²

These trends also exist in key military installations like the closed missile cities. Although the desire to emigrate is not as high as was feared, demoralization is widespread and high enough to be alarming. Ever more scientists make ends meet primarily from moonlighting for other organizations

that can pay. Fewer and fewer specialists are being educated at the best centers in Moscow. As opportunities decline and assignment to closed cities is no longer feasible, those cities can replenish their labor force only from within. All these trends point to a decreasing capability to provide ever more sophisticated future missile and nuclear systems.²³

Although Putin has announced measures to promote and retain scientists, especially in the defense sector, the trends are not promising.²⁴ Neither are they encouraging for the future due to shortages of funding for education and a decade or more of misplaced priorities. The “internal and external brain drain” obstructs Russia’s full exploitation of the current technological revolution.²⁵

Barring a major reversal of trends, Russia, between 2010 and 2020, could lose the capability to keep pace with advanced Western and Asian countries (Japan, India, and China) in defense technologies. This does not mean Russia will be unable to field a reasonably robust strategic force consisting of weapons based on new physical principles, space and informational weapons, chemical and biological weapons, and a large tactical and strategic nuclear deterrent, the latter consisting primarily of some 750-1,000 land-based intercontinental ballistic missiles (ICBM). Nor does it preclude an ability to wage at least some forms of IW.

What it does mean is that the ability to produce sufficient ACWs; precision-guided munitions (PGM); and space, informational, and high-tech systems using advanced information, bio-technology, and electronics will be severely though not totally constricted. Russia’s mobilization base will remain severely inhibited relative to past capabilities. Hence Russia’s capacity to wage sustained war in any of these domains could fall below its current level. Still, Russia retains a strong capacity for waging IW against American targets.²⁶

This analysis suggests that, despite high military spending, the unlikelihood of major structural reform in the

government, economy, and military, and the continuing war in Chechnya will prevent Russia from soon deploying what its rulers believe are sufficient conventional forces to defend and advance its interests. Given the concurrent demographic challenge, the reliance on both strategic and tactical nuclear weapons and/or on a relatively small number of ACWs and information systems comparable to them could continue to dominate defense policy in practice, despite official proclamations and even spending to the contrary.

Russian military thinkers recognize these difficulties and discuss three different possibilities for surmounting them. The first is a massive increase in foreign support through arms purchases or subsidies. The second is a major domestic economic-technological breakthrough resulting from broad economic-political reform. The third is a major, albeit limited, breakthrough in the defense industrial sector that will generate tremendous returns in the civilian sector over time. Each of these possibilities is unlikely to succeed. Trying to secure a massive increase in foreign support through arms purchases or subsidies ignores how difficult it will be to upgrade Russia's decrepit infrastructure without Western and American support. But some officials now advocate an openly anti-American policy of military sales to America's enemies, a policy whose overtness can only increase external economic pressures on funding sources, while not appreciably increasing arms sales revenues.²⁷

So far as a major domestic economic-technological breakthrough due to broad economic-political reform is concerned, this, too, seems unlikely to succeed because the government is retreating from democratization and transparency, restricting the free exchange of information and taking control of the Internet. The various moves towards police-state repression, like legislation to control the Internet, argue against a decisive breakthrough to an information society and information-era military.²⁸ These actions also herald an autarkic development pattern that is

quite contradictory to contemporary requirements and will produce further obstacles to reform.

Finally, there is the third alternative, a major but limited breakthrough in the defense industrial sector that will generate enormous returns in the civilian sector over time. This appears to be the preferred path of the current government and fits with its statist outlook, to include economic planning and control. Unfortunately, this is a move backwards, because today's revolution in military affairs, contrary to Russian elite thinking, has been largely spawned by new civilian technologies and companies. Therefore, this line of action seems wrongheaded from the start and will not produce lasting benefit.

HOW RUSSIA THINKS IT CAN SQUARE THE CIRCLE

Spend More.

Faced with all these challenges, Russia's military planners have reverted to old solutions. One is to increase funding to a more centralized defense industry, and the other is to increase foreign capital flows by exporting more arms.

Russia's defense sector is still too large. In 1999 the government exceeded the annual budgetary figures on defense and spent another 56.8 million rubles on domestic security. That figure also exceeded the stipulated budget. This suggests the extent of the burden on state finances wherein defense spending already consumes between 20 and 25 percent of the official budget, not counting the extra-budgetary spending defense receives.

Yet, even with these measures there is never enough. The related military and industrial constituencies are now actually getting 5 percent of the annual gross domestic product (GDP), not just the 3.5 percent that Boris Yeltsin had promised when he was president. This percentage will likely increase as the economy grows, and the Chechen war

continues. Stated military requests continue to exist in the realm of illusion. To sustain future programs, the government has indulged in its own fantasies by raising the defense budgets annually since 1998. For 2001 it raised official spending on research and development (R&D) by 43 percent and cut procurement by 13 percent. This reflects the commitment to rely temporarily on nuclear deterrence, even as missiles go gradually out of service and are replaced at the rate of 10 ICBMs (mobile SS-27s or *Topol-Ms*) per year.²⁹ All the military spending in 2000-2001 added to the original draft budget for 2001 totals over 50 percent of the original draft.³⁰

Hence, there is a direct linkage to the crisis in science and technology. Science Minister Alexander Dondukov observed that most of the industrial growth in 2000, about 10 percent, was due to high-tech branches.

In March 2001, Alexander Roubtsov observed that the defense industry still includes about 1,700 plants and a labor force of 3.5 million. With families, this comprises about 10 percent of Russia's total population and embraces all of Russia's territory. There are still over 70 factory cities and restricted administrative-territorial entities totally dependent on the defense industry. Since these institutions remit taxes to regional and provincial leaders, they worry that any marketization will lead many of them, which are generally noncompetitive, to close down, face high unemployment, or lose revenues. Those factories placed under central control will now pay taxes to Moscow, not to the regions. Thus the projected reform of defense industry is also part of Putin's overall centralization plan.³¹ Meanwhile defense production is about 6 percent of the 1991 level.³² Therefore, Dondukov et al. push arms sales and technology transfer wherever possible regardless of international agreements. Yet, while policy now focuses on upgrading existing equipment, some firms either want to produce utterly new weapons that cannot be bought, or are simply waiting for orders from Moscow without any conception of a market system.³³

This suggests that if Russia follows Putin's course through 2020, it can, given the preservation of the Soviet capital stock and possible added value from the CIS and foreign subsidies, approach the Soviet level of conventional weapons. But given the attrition and qualitative decline of capital and labor assets in the scientific and military sectors, that is the best that can be hoped for from the surviving shell of Russia's nonmarketized defense economy.³⁴ Despite higher investment due to moderate growth and high energy prices, Russia will probably remain 30 years behind the West in applied technology. There will be pockets of excellence but not a truly competitive military machine.³⁵

Use Budgetary Tricks.

To fund this program, more extra-budgetary tricks will be used.³⁶ The goals of such strategems in helping the defense and science sector are quite transparent. Deputy Prime Minister Ilya Klebanov, who supervises defense industry and arms sales, stated that the government will spend 135 percent of what it did in 2000 on defense contracts through 2010 and give priority to new fifth-generation aircraft and air defenses, tanks, and ships. These systems include new sea-launched strategic missiles, cruise missiles, a fifth-generation fighter jet, and new infantry fighting vehicles, tanks, and armored personnel carriers. Until these "wonder weapons" are ready (and bearing in mind that this funding excludes weapons based on new physical principles, information weapons, command, control, and communication and intelligence [C3I] systems, nuclear weapons, etc.), the armed forces will have to rely on upgrades to existing equipment.³⁷

Obtaining all these new capabilities would entail recentralizing state power and unifying defense industries under virtually monopolistic state ownership. Animating this program is the key players' neo-Stalinist ideology that defense industry is the locomotive of recovery. This is hardly

surprising since most high-tech research originates there. Deputy Defense Minister Nikolai Mikhailov stated that since the military are regular consumers of science and technology (S&T) products, they can fulfill any combat mission using those systems “only in the event of the maximum and effective use of the potential of domestic science, engineering, and economy. I emphasize domestic.”³⁸ Accordingly, this sector is the permanently operating catalyst of technological recovery whose role in the development of new technologies is worldwide. This utterly false and misleading idea is belied by global economic reality.³⁹ Since Russia globally lags in computers and technology exports, and risks falling even further behind, Mikhailov outlined a comprehensive program of military-technological modernization designed to bring Russia back to a competitive level in 5-7 years.⁴⁰

Mikhailov outlined key areas for Russia in which it must compete given the rising American threat. These include space and missile engineering to build *Topol*-Ms, missile defenses, a new generation of space apparatuses “for various targeting procedures,” aeronautical engineering for new fighter planes, anti-air and air defense engineering, 4th and 5th generation submarine missile cruisers, heavy aircraft-carrying cruisers, precision guided missiles, tanks, command and control systems for ground forces, domestically built highly integrated microprocessors, super-computers, and neuroprocessors, etc.

To obtain these systems, Putin has reconcentrated arms sales and defense industry under his control, supposedly to maximize revenues. To raise exports he has merged Russia’s arms exporters into one group under his direct authority. That group will also force central control of all intergovernmental military-technical commissions, except those for China and India which Klebanov controls, and will issue licenses for foreign exports. This will supposedly force many smaller or noncompetitive plants to concentrate resources and production and create truly marketable products. Putin also decreed cuts of over 600,000 mostly

administrative jobs in defense industry through 2006, possibly closing factories and even whole design groups. The aerospace and shipbuilding industries in particular are supposed to be drastically concentrated into state-controlled holding companies.⁴¹

By August 2000, observers had already seen that this plan essentially returned to the Soviet model.⁴² Vitaly Shlykov, one of Russia's foremost experts in defense economics and a scathing critic of the system, noted that the arms sales program is a Ponzi scheme, since Russia is selling weapons it cannot yet produce and using revenues obtained from preliminary agreements on them to finance that production.⁴³ The system is so broken that, at best, it produced only 10 percent of Soviet defense output in 1991. Ninety percent of the 1,700 defense firms have no orders and could not fulfill them if they received them, and subcontractors have lost interest in dealing with the system. Whereas 800,000 people work in aviation and aerospace in Russia, compared with 98,000 in Europe, Europe's production is more efficient, and its volume is greater. Russian military hardware's real costs are so high that they approach Western costs. Given the low quality of production and workmanship, Russia is actually at a disadvantage. While the few producers and exporters who have been privatized are profiting and finding a way in the market, Klebanov and Putin are nationalizing the defense industry. By restoring the Soviet model, Moscow almost certainly ensures the system's ultimate failure. Conventional and nuclear missile branches (since the latter are to be severely cut) will break down and the Russian Ministry of Defense (MOD) will have to finance the entire rearmament out of its own budget.⁴⁴

The Poverty of Budgetary Tricks and Selling Arms.

Spending and budgetary tricks and foreign arms sales will not be able to fully fund Russia's strategic weapons acquisition ambitions. The key reason is that they currently

are spending more than they can afford, and their plans would have them spending even more. We can estimate the extent of defense spending and its likely direction to 2020. First, assumptions of massive reductions in Russian defense spending since 1991 are unduly optimistic. At least some analysts believe that total current Russian spending on its armed forces, including spending by regional and local governments to maintain the military (which is much greater than the published budgetary figures), approximates (as of 2000) the expense burden of the military upon the economy during Soviet times.⁴⁵

Second, the armed forces and defense industry survive on the basis of hidden or unreported noncash and/or extrabudgetary subsidies. This opacity extends as well to the armed forces which cannot even keep track of their own expenses. Spending by the armed forces, therefore, includes not just the debts owed to the MOD since 1992, but also the debts owed by the armed forces for procurement that is not paid for.

Third, military spending remains much greater than assumed in the West. Christopher Hill of the United Kingdom's Ministry of Defence estimates that actual spending in 2000 was 143 billion rubles, rising significantly from 1999, with the official defense budget amounting to little more than half of true defense spending.⁴⁶ Based upon computations in constant 2000 prices, he and MOD argue that defense spending fell from \$130 billion in 1992 to \$42 billion in 1998. In 2000, however, Putin increased the official budget outlays by 50 percent, and at least some aspects of R&D by 80 percent.⁴⁷ Since then, defense spending has risen to \$50 billion in constant 2000 prices. Also in 2000, the trend towards increased funding for strategic forces, influenced by then Minister of Defense Igor Sergeev, apparently gave way under pressure from Chief of Staff General Anatoly Kvashnin and others to more funding of the regular conventional forces, procurement, and R&D on new higher-tech systems. Recently it was announced that the government intends to impose an even

50-50 ratio by 2011. Hill's figures are roughly confirmed by the International Institute for Strategic Studies (IISS) in London, which assumes total defense spending of \$57 billion.⁴⁸

Notwithstanding continued growth, the most likely major sources of underwriting for those rising outlays are arms sales and joint projects with other states. Many industry insiders and observers believe that only this "transnational" integration with foreign clients keeps this industry going.⁴⁹

Hill argues that, however one slices this cake, it cannot lead to a massive resurgence of military power. Indeed, the numbers of troops will be slashed, and demography is pushing Moscow towards a professional army though its officers viscerally reject the idea and show no understanding of what that means.⁵⁰ Force structures will be transformed, too, with armored vehicles, tanks, combat aircraft, and major naval platforms likely to be cut by a third.⁵¹ Furthermore, spending on current procurement is largely restricted to upgrading existing weapons and reorienting R&D funds toward the next generation of systems or entirely new kinds of weapons, while squeezing every drop of deterrence out of the existing nuclear systems.⁵² New systems are going abroad, not to Russian forces, to sustain defense industry until a reduced military can actually buy enough weapons.

These figures entail a reduced nuclear force and lower rates of production of new generations of nuclear weapons. They also suggest that Moscow is stressing current R&D of high-tech combat aircraft and electronic, control, and information systems, and weapons based on new physical principles and the use of TNWs in conventional conflicts. Though estimates of the future size of the nuclear forces vary greatly, undoubtedly Moscow can sustain a land and sea dyad, or perhaps a triad with a small aerial leg of 750-1,000 missiles as a minimum, more than enough to guarantee a second-strike capability by 2015. General Staff

analysts also say that, as of 2007, Russia will still have some 3,000 tactical nuclear warheads. So Russia should be able to field about 1,000 TNWs by 2020 if it starts building them now.⁵³ Given the external linkages that Moscow is forming and the expectation of economic growth through 2020, Russia could probably also sustain several pockets of excellence regarding space, ASAT, information, and perhaps new weapons.

But since a concealed capability for surge production exists within Russian industry, Russia could produce and export these weapons provided there is sustained growth and a robust technology sector. Russia needs sufficient financial resources to generate those capabilities, although it would remain qualitatively behind the most advanced leaders in defense production. However, the issues of growth and a robust technological sector present more problems than are commonly realized.

Securing Foreign Technical Cooperation.

What kind of inputs into Russian technological and military capabilities will provide Moscow with security, deterrence, and a strategic warfighting capability by 2020? Clearly the leadership wants to invest in modernized nuclear weapons, dual-use information systems, and ACWs. Russia also is pouring large funds into research on directed energy weapons: lasers, microwave radiation emitters, and particle-beam generators using subatomic particles to destroy targets at the speed of light, a new mass plasma weapon that could ionize the atmosphere and destroy incoming missiles and enemy aircraft, anti-stealth radar, stealthy air-launched cruise missiles, newly tested anti-aircraft and anti-missile systems, and a plasma coating to make fifth-generation Russian aircraft invisible. These programs broadly comport with policy directives from the top to make Russia a competitive player in advanced, conventional, high-tech platforms and systems, including informational and perhaps biogenetic technologies.⁵⁴

These enormous programs are probably being financed by foreign capital flows. As James Oberg recently observed, the government in 2000 earned \$800 million from sales of space services, two-thirds of which was profit, besides receiving several hundred million more from the Russian government.⁵⁵ Space launches and other foreign sources that fund programs like the Cooperative Threat Reduction (CTR) Program and related efforts to manage Russia's nuclear arsenal, perform their stated mission, and let Moscow fund systems that would otherwise not be available for defense modernization. Other sources could also become available for that purpose.

For instance, Russia's state-owned domestic oil and gas industries currently operate at 50 percent of capacity. If energy prices remain high and Russia's productive capacity grows, the government can then reap \$50-100 billion annually. Obviously much of that funding could go into defense production. Russian weapons production rose 60 percent in 1999-2000, suggesting the depth of available surge capability for conventional and nuclear weapons, not to mention new forms of biological and chemical warfare.

Therefore, Russian defense industry possesses a great deal of unused production and even surge capability, especially if it can be augmented by linkages to CIS plants and new sources of capital. Those revenue sources would allow Russia to modernize nuclear, information, chemical, and biological weapons by easing the burden on the government to finance exclusively the demobilization of obsolete systems. Another source of funding is expanded arms sales abroad, mainly to China, India, and perhaps Iran. Putin and the defense industry share the Soviet delusion that arms sales are a, if not the, locomotive of general industrial recovery.⁵⁶ Consequently, Putin aims to reorganize defense industry and arms sales programs to ensure greater state control and profitability of both these instruments of policy.

The surprising tenacity of this delusion and the consequent political strength of Russia's defense industry are a major explanation of that lobby's ability to obtain a continuing, though smaller, high level of funding from an exhausted economy and society, even though an uncontrolled defense industry is now seen as one of the major causes of the Soviet collapse.

Meanwhile, Moscow views the expansion of military sales abroad in a long-term context. For example, China is Moscow's biggest client, online to buy an estimated \$15 billion worth of weapons through 2004-2005. Actually their agreement is for 15 years and contemplates **ultimate joint production of both conventional and strategic systems**. Russian sources claim that bilateral military contacts have doubled or tripled since 1999, thus corroborating Alexander Nemets and John Scherer's assertion that the total of all known Russo-Chinese military-technological exchanges approximates \$5 billion a year through 2004, doubling the rate for 1996-99 and quadrupling the rate of annual arms sales for 1991-96.⁵⁷ Moreover, these figures omit "black" or classified programs and the extensive scientific-technological exchanges among Russian and Chinese scientists whose scope, extent, and parameters cannot be determined.

Russian analysts describe such military exchanges, which they claim will give Russian factories abundant orders for at least 5 to 7 years, as "primitive forms of mediation in military trade." They want the next phase of Sino-Russian military bilateralism to focus on a relationship that goes beyond Russia selling and China buying to more "advanced" forms, e.g., joint development and manufacture of munitions and weapons.⁵⁸ This outlook harmonizes with the idea of the 15-year cooperation plan and focuses on the perspective of increasing jointness.

During the first 5 years (2000-05), China would purchase from Russia up to \$15 billion of new generation weaponry in the form of either manufactured items or

production licenses. Meanwhile, joint exercises and military training would be expanded across all branches. Perhaps the most important aspects of the Sino-Russian military cooperation would be in the areas of joint research and development for the next generation of airplanes, missiles, and laser-based and other high-tech weapon systems. Joint efforts in developing these systems would be the focus for the second and longer-term phase of the plan (2005-15).⁵⁹

Russian officials have also indicated that if the United States builds missile defenses, Russia and China will cooperate jointly to resist or penetrate them.⁶⁰ That cooperation would undoubtedly involve some of the technologies and weapons contemplated in the 15-year plan. Joint production could entail some fungibility of strategic systems between Russia and China, further complicating an assessment of either state's future capabilities. We may also assert that it is likely that the next major advance in Russian space and/or satellite technology will occur in behalf of either Iran or China, which are both obtaining or being solicited to buy Russian models of spacecraft and satellites.⁶¹

Russia's new agreement with Europe on the European Air Defense System (EADS) also offers major contracts to sustain the aerospace and air defense industries while providing access to European funding, technologies, and defense decisionmaking.⁶²

The Need to Reform.

Moscow's remedies clearly regress to an autarkic, state-controlled system based on restricting the flow of information and attempts at preferential treatment for the military and future scientists. They also are based on Mikhailov's and Putin's Stalinistic fantasies concerning defense industry. Although high-ranking officials have laid out high-tech objectives, a neo-Stalinist defense economy based on raw materials exports and a shrinking base of

competitive military production, as well as the crushing demographic and infrastructural problems, cannot provide those systems and still manage to compete with other major powers. But the size of the Soviet nuclear, biological, and chemical weapons complexes, Moscow's abiding reticence about these programs, and repeated claims that it cannot afford to destroy some 40,000 tons of chemical weapons (the largest program in the world), make it likely that either those weapons stocks will continue, be preserved, or be ready for quick reconstitution.⁶³

The precise number of nuclear weapons also depends on foreign developments, particularly the fate of the American missile defense program and Chinese modernization, as well as on the success of economic reforms and conventional modernization. Putin's approach entails considerable structural remilitarization and coincides nicely with his overall progress towards a neo-imperial authoritarianism.

On one hand, if we are wrong and Russia can prevail in its war with Chechnya and successfully deal with other conventional threats by restoring some measure of its former conventional weapons power, Russia can successfully reduce its dependence on nuclear weapons and continue to follow the long-term trend towards fewer but more survivable and precise nuclear weapons, including tactical nuclear weapons. While the nuclear deterrent will be smaller, Russia's high-tech, IW, and space capabilities will be greater. On the other hand, if defense and economic reforms fail by 2020, as this chapter projects, then Russia will have to stop cutting nuclear weapons, including TNWs, and instead rely more on them as well as on chemical and biological systems, given the defects of its conventional defense systems and war economy. Space and IW capabilities will become even more prominent and unstable precisely because of Russia's overall instability.

Indeed, if reform fails or the external environment becomes truly menacing, Russia might even become unable to cope. Then some of the nightmare scenarios of state

decomposition feared by the Russian elite might come to pass. While Moscow undoubtedly can retain usable “strategic” capabilities—nuclear, biological, chemical, informational, and space weapons—until 2020 or develop some new ones, the faster it tries to develop those weapons by the means currently employed, the fewer it will develop, the harder it will be to develop them, the worse their quality or sustainability will be, and the greater the likelihood of Russia’s continuing military decline. In this connection, the Russian armed forces’ ability to stonewall its own and foreign governments regarding the reduction of its huge chemical and biological warfare stocks is of great concern and must be overcome.⁶⁴ For today’s Russian elites that is an unacceptable conclusion. Yet to avoid these nightmare scenarios, they continue to run on the treadmill of reform to recapture the past, not to keep up with the present.⁶⁵

ENDNOTES - CHAPTER 2

1. Russia’s military may try to resolve this dilemma by increasing its dependence on its most mature, high-leverage weapons capabilities—i.e., its nuclear, biological, chemical, and informational systems. The costs of retaining and developing these specialized strategic capabilities, however, will only further accelerate the overall decline of Russia’s general military forces.

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CHAPTER 3

RUSSIAN RULE AND THE REGIONAL MILITARY INDUSTRIAL COMPLEXES

Ariel Cohen

Introduction.

Since the collapse of the Soviet Union, the U.S. Government and the West in general have been concerned about the proliferation of weapons of mass destruction (WMD) stemming from the far-flung Soviet/Russian military-industrial complex. Beneficiaries of weapons proliferation may include rogue states and terrorist organizations acquiring nuclear WMD, e.g., warheads and missiles; chemical and bacteriological weapons, such as toxins and bacteria/virus cultures; and ready-made technology to produce all of these. In addition, the U.S. Government and the American expert community have raised concerns about the safety and accountability of materiel, such as weapons grade uranium and plutonium. The unsafe storage of radioactive materials in civilian use, ranging from fuel for nuclear power stations to trans-uranium substances used in medicine and research, represent a proliferation threat, as it is possible to acquire and enrich such materials to weapons-grade levels, or use them in dirty, sub-critical devices. A separate but related issue is the availability of experts capable of developing strategic systems who are for hire by rogue states, whether the projects the experts contract for are completed abroad or while they continue to reside in Russia.

Problems with control over strategic weapons and nuclear materials in the regions have been widely reported on all levels: at the federal center, in the military, in security/law enforcement, and in the national economy. This chapter will examine the factors affecting proliferation, and will draw conclusions regarding the interaction between proliferation and questions of center-periphery relations.

Conventional wisdom holds that the decline in resource allocation to maintain Russia's far-flung military-related facilities is encouraging the scientists and managers of these facilities to sell their goods abroad. Yet some believe that local economic and environmental concerns have also encouraged local authorities to contain and restrict the activities of these facilities. This chapter will identify the factors determining which of these trends is likely to be prevalent.

The conclusions are far from hopeful. In view of the overwhelming evidence that the military and the Russian military-industrial complex are the leading proliferators, there is little reason to believe that local authorities have either the motivation or the power to act as efficient inhibitors of proliferation.

The pervasive corruption among national and local authorities; inadequate and corrupt law enforcement; powerful criminal organizations with links to global organized crime; severe problems of budgeting insufficiency and irresponsibility in Moscow and at the regional (*oblast*) levels; lack of interaction between nationally owned facilities and local governments; and turf battles between the center and the local governments, all combine to make the Russian military-industrial complex and the civilian facilities of the Ministry of Atomic Energy (Minatom) leaky and dangerous vessels bearing some of the most deadly weapons systems and technologies on the planet. As these vessels sink, WMD technologies are being sold and smuggled out of Russia.

At the time of this writing, evidence abounds that proliferation of strategic weapons is under way, with the complicity of Russia's central and regional authorities. It seems that the government of Russia, the U.S. Government specifically, and Western allies as a group failed to develop a comprehensive strategy to address this issue, and a quick and comprehensive solution to the problem may not be achieved in the near future.

The Russian Military and The Military-Industrial Complex: Primary Agents of Proliferation.

As the Soviet Union collapsed in the wake of Mikhail Gorbachev's rule, a taste for personal enrichment spread within the ruling communist bureaucracy. During the period 1988-90, economic liberalization under "self-sufficient accounting" (*khozraschet*), and the Law on State Enterprises, promulgated in 1988, allowed state-owned economic units to sell their production at state prices to small commercial firms set up by their managers, which could in turn sell the goods abroad at international market rates. For the first time since Lenin's New Economic Policy of the 1920s, the outlook of Russia's industrial managers began to change, as profit once again became the main motivating force behind economic activities. The call was, "Get it while you can." Unfortunately, the pursuit of profit in the absence of the rule of law and adequate mechanisms of control opened the Pandora's box of weapons proliferation.

The Economic Roots of Proliferation.

By 1990, assets were being transferred from the state pocket to a vast number of companies set up by the Central Committee of the Communist party with the participation of its most trusted agents, usually from among Committee for State Security (KGB) officers and others. These "red directors" were joined by military and security generals in gigantic asset-stripping schemes. During this period,

industrial enterprises, including those in the military-industrial sector, began selling strategic stockpiles of raw materials, an activity that was previously punishable by death.

For the first time in Soviet history, unprecedented events in the area of licit and illicit foreign trade in military-related goods were noted by Russian and Western observers. For example, ANT, a company with ties to Prime Minister Nikolay Ryzhkov and other senior Soviet officials, was caught trying to sell and ship modern Soviet tanks (T-80s) and other military equipment out of the port of Novorossiysk.

In 1990-92, while serving on the Board of the California-Russia Trade Association (CARTA), a small non-profit organization, I witnessed a flurry of faxed business offers from the Soviet Union (and later Russia) containing proposals to sell anything from rare metals used in military production to military equipment, helicopters, and aircraft. The floodgates of the Soviet economy, bottled up for 60 years, had suddenly burst.

This General Went to Market.

As Gorbachev negotiated the withdrawal of Soviet troops from East Germany, the Soviet generals launched “economic” activities, selling off military materiel and equipment worth billions of U.S. dollars. For example, the Western Group of Forces (Zapadnaya Gruppa Voisk, or ZGV) entered frenetic economic activities, selling vast supplies of the fuel that had been stored in East Germany for the Soviet Army’s future thrust into Western Europe and the conduct of World War III.

General Pavel Grachev, who later became President Boris Yeltsin’s Minister of Defense, and General Matvei Burlakov were often mentioned in the Russian news media as being leading culprits of this sell-off. Grachev even earned the nickname “Pasha-Mercedes” for allegedly using

Russian transport aviation to import luxury cars, such as Mercedes Benzes and Volvos, into Russia. Both Grachev and Burlakov were linked to the murder of investigative journalist Dmitrii Kholodov, who was assassinated by an exploding briefcase after publishing allegations of high-level corruption in the military. The head of an intelligence unit with the Russian air assault troops was convicted of the Kholodov murder years later.

The 1990s yielded a bumper crop of accusations of and indictments for corruption in the post-Soviet military. In addition to Grachev, Air Marshal Shaposhnikov, the last Soviet Minister of Defense, was fingered in the news media as being deeply involved in corruption. Colonel-General Konstantin Kobets, one-time acting Minister of Defense of the Russian Federation and a hero of resistance to the 1991 putsch, was sentenced to a relatively short jail term. A Pacific fleet commander, an Air Force Major-General in the Far East Military District,¹ as well as a number of general officers in the strategic rocket forces were accused of corruption. Some were dismissed, but very few were actually convicted. Generals also in a few cases used conscript labor to build villas and to farm out labor to civilians for construction and other projects—an activity both corrupt and harmful to the morale of their troops.

Russia's junior officers were not far behind their leaders. In Murmansk, headquarters of the Northern Fleet, five naval officers were arrested and charged with attempts to sell radioactive rods from a number of nuclear submarine reactors anchored in the bay. In a particularly notorious case, the former head of Pacific Fleet counter-intelligence became an operations officer for one of the organized crime gangs in Vladivostok, headquarters of the Pacific Fleet. Thus, towards the end of the Gorbachev era and throughout Yeltsin's rule, the Russian military demonstrated pervasive corruption, often at the highest levels. Moreover, with the beginning of the war in Chechnya (December 1994), reports began to surface alleging sales of weapons to the Chechen rebels seeking independence. Some cases of officers selling

conscripts to the Chechens as slaves or to be ransomed later by their families were also reported in the news media. Unauthorized sales of Russian and Ukrainian weapons were publicized, as wars raged in the former Yugoslavia and Africa.

It was only a matter of time before the trade would begin in WMD systems, components, and technology. In one of the more notorious of such cases, General Anatoly Kuntsevich, former head of the Russian chemical weapons program and later adviser to Yeltsin on chemical disarmament, was caught selling chemical precursors to binary weapons to Syria. In 1995, he was charged by the Federal Security Service with selling 800 kilograms of chemicals in 1993 and five and half tons in 1994.² Still, Kuntsevich did not serve out his jail term.

Even more disturbing are reports that Aum Shinrikio, a Japanese doomsday cult, reportedly obtained chemical weapons from Russia. It used the deadly nerve gas Sarin during its 1995 attack on a Tokyo subway station. There were reports that Aum was also negotiating for the purchase of a nuclear warhead from Russian sources. An even greater cause for concern is reports that Osama bin Laden's Al-Qaeda terrorist organization, harbored by the Taliban regime in Afghanistan, attempted to acquire nuclear capabilities. Bin Laden may have the means, the dedication, and the motive to do so.³

An American researcher and former Pentagon official, Phil Petersen, claimed that while visiting Russia on a research project in 1992, a missile base commander offered to sell him a decommissioned SS-20 missile. Although Russia was supposed to have destroyed all of its SS-20s under the Intermediate-range Nuclear Forces Treaty (INF), several apparently were stored "for instruction purposes." The Clinton administration refused to go ahead with a sting operation to catch the culprit.⁴

Not only missiles but also submarines were available for sale. U.S. law enforcement authorities thwarted an attempt

to sell a Russian submarine to a Colombian drug cartel, complete with a crew and a vice admiral to command the vessel. Senior officials in the Ministry of Defense in Moscow were supposed to clear the submarine sale. An almost completed sub, along with blueprints in Russian and various components, was discovered in the Colombian jungle—yet another attempt to sell a sensitive weapons platform to a drug cartel.

As James Woolsey, former Director of the Central Intelligence Agency, testified,

If Russia either follows the path of Weimar Germany's collapse into fascism or breaks apart, our problems in this regard will become far more severe. At the heart of the matter is Russia's failure, in the aftermath of the fall of the Soviet Union, to establish the rule of law.⁵

Woolsey pointed out another important phenomenon which U.S. authorities dealing with Russian proliferation were slow to understand—the nexus and inter-penetration between Russia's security services, organized crime, and Russian firms, which regularly do business with the two other segments of the corrupt Russian society.⁶

The Russian government often tolerated and sometimes even facilitated these transactions. For example, Evgeny Primakov, in his capacity as chief of the foreign intelligence service (SVR), foreign minister, and prime minister, was interested in these sales as a means to curry favor with his supporters in the armed services and the military-industrial complex. Primakov scored points with the political “red-brown” coalition, which supported both his foreign policy and his prime ministership.⁷ In addition, Primakov, who cultivated high-level contacts among most radical and anti-American Middle Eastern leaders, could easily facilitate weapons sales. Another politician who developed expertise in promoting arms sales, particularly to Iraq, is Vladimir Zhirinovsky, the rabble-rousing, ultra-nationalist leader of the Liberal-Democratic Party.

People living in the relatively orderly Western world, ruled by laws and lawyers, have a difficult time fully grasping the dire significance of the phenomenon described by Woolsey. This was a merger between a sophisticated and ruthless global intelligence service, criminal organizations with world-wide reach, and a decaying and corrupt military possessing sufficient resources, including WMD, to wage an intensive nuclear world war. As of 1990, there were no government, no laws, and no legal mechanisms to stand in the way of the unprecedented opportunity to proliferate strategic weapons.

Regions in Chaos: From Decentralization to “Strengthening the Vertical Flow of Power.”

The dynamics of center-periphery relations affected Russia’s proliferation of WMD in the 1990s, and will continue to do so in the new millennium. During 1992-99, the executive power in Russia’s federal government rested with an erratic and increasingly ill Boris Yeltsin. While not a dissident, Yeltsin had at least some inclination toward promoting a “Russia of regions,” and experimented with a federal structure that delegated some authority to regional governors and the presidents of ethnic constituent republics of the Russian Federation.

Weak Center and Feeble Control: The Yeltsin Years.

In the beginning of Yeltsin’s tenure (1991-92), governors were nominated, but after the adoption of the Russian Constitution in 1993, they were elected. Yeltsin’s political advisers included a number of academics who sought to build a federal structure different from the rigid Soviet system. These included Leonid Smirniagin, a Moscow State University political geographer who was Yeltsin’s adviser on federal affairs; Georgy Satarov, a liberal political scientist who became Yeltsin’s political aide; and Emil Pain, an expert on ethnic affairs who advised on nationality issues. The period of the early 1990s is best summarized by

Yeltsin's famous call to the regions, "Take as much sovereignty as you can carry away."

In some cases, that dictum was taken too far, too fast. Moscow could not stomach the attempts of Chechen president General Jokhar Dudaev to declare independence. A long and bloody war ensued, which continues to this day. Tatarstan had negotiated a more autonomous status for itself than other ethnic republics, which were somewhat more independent from Moscow than the regular regions. However, the loosening of Moscow's grip on the provinces, and the poor leadership of the armed forces, which tolerated corruption and the sell-off of military hardware, resulted in more emboldened governors, local military commanders, and others pursuing risky deals which involved increasingly sophisticated weapons.

While dozens of incidents of nuclear smuggling were reported during the 1990s, security experts believe that only 10-15 percent of these activities were uncovered. While in most cases the amounts of intercepted radioactive materials were too small to produce even a single nuclear weapon, some experts believe that these were samples, and that larger amounts of uranium and plutonium may have been shipped to customers. Moreover, the higher the rank of the officials involved, the better their capabilities to cover up the smuggling and the smaller the chances of their being apprehended.

In any event, during this period most of the military and military-industrial facilities with the potential to proliferate were under federal control—that of the armed services, the Ministry of Defense, and the ministries in charge of military production. What facilitated smuggling in the 1990s were loose border controls, corrupt customs officials, and ill defined (and sometimes, nonexistent) laws. Local generals were sometimes dependent on the governor's largesse, while Federal Security Service (FSB) commanders in the regions were either in the local oligarchs' pockets or engaged in business themselves. Federal prosecutors'

offices in the region did not function well, to put it mildly. Thus, the bureaucratic structures that were supposed to prevent proliferation by investigating, apprehending, and prosecuting the culprits were corrupt and inefficient.

Russia was dizzy with its newfound freedom, and often put it to ill use. Still, WMD smuggling was an activity that carried a high risk and uncertain reward. Many other commercial ventures, such as trade in oil, gas, and metals, were both safer and more lucrative. Still, regional leaders in the government, business, the military, and organized crime were minor league players in comparison with their Moscow betters. The center, on one hand, led the way in proliferation activities, while on the other, it lacked the tools to effectively prevent such activities when undertaken in the regions.

Recentralization under Putin.

The rise of Vladimir Putin and the allied group of St. Petersburg FSB officials, businessmen, and government bureaucrats changed the tone, but not the substance, of proliferation as related to federal control over the regions, and center-periphery relations. By appointing seven presidential plenipotentiary representatives (governors-general), five out of seven of them former KGB and military generals, to oversee the regions, Putin changed the constitutional make-up of Russia without changing the Constitution. These presidential envoys have already been nicknamed “sovereign’s eyes.” They will obviously report to the Kremlin about any suspicious activities undertaken in their region, including anything as politically lucrative and sensitive as sales of WMD and related technology.

Through this latest reform, Moscow is attempting to reassert its control and to diminish the power of the elected governors. As part of Putin’s new order, the regional governors will cease to be ex officio members of the Council of the Federation (the upper house of the Parliament). Instead, they will appoint “senators” to represent the

regions in Moscow. By diluting the prerogatives of the governors, the Kremlin is attempting to consolidate its authority. Rumors abound that constitutional reforms will be introduced, cutting down the number of Russian regions from 89 to 30-40. Thus, at least theoretically, it will be more difficult to engage in proliferation activities under Putin's rule **without the Kremlin's approval and financial "participation" in the profits.** However, this does not necessarily mean that proliferation will become more difficult—just more orderly.

While reports of corruption continue unabated, a survey of those named indicates that the Prosecutor General's office has been used as a political battering ram against hostile oligarchs, not as an institutional tool to fight official graft and organized crime. Few, if any, high profile corruption trials have taken place under Putin thus far. No prominent criminal "godfathers" have been jailed. The only public investigation focusing on Ministry of Defense generals who allegedly committed embezzlement involves former Ukrainian Deputy Prime Minister Yulia Timoshenko and former Russian Deputy Minister of Finance Sergei Vavilov, and their alleged offense was purely financial fraud, not corrupt proliferation activities. This investigation may have been a part of a political struggle to bring the Ministry of Defense under control of Putin's political appointees. No trials of high-level generals from the military or the FSB have taken place so far—for proliferation or otherwise.

On Putin's watch, as under Yeltsin, the most crooked officials are either quietly dismissed or pushed out, often being given prestigious jobs. For example, after being dismissed, Governor Evgeny Nazdratenko was appointed Chairman of the State Committee (Minister) of Fisheries, while Governor Nikolai Kondratenko of Krasnodar was approved for appointment to the upper house (the Council of the Federation) by his handpicked successor.

Putin himself has admitted that the Customs Service is beyond repair, and that he cannot see a way to clean it up. Governors and presidents of the autonomous republics are learning to coexist with Putin's viceroys, sometimes publicly trading barbs, as in the case of the young and brash former Prime Minister Sergei Kirienko, special envoy for the Volga area, and Tatarstan's erstwhile President Minitmer Shaimiev and Bashkortostan authoritarian Murtaza Rakhimov. However, in most cases, the regional leaders cooperate in business areas, rather than conduct open political warfare.

Two areas of concern have emerged to date under Putin's rule: first, with a more pliant mass news media, Russia is becoming less transparent. If, under Yeltsin, reports of high-level corruption in the military and arms exports, including WMD proliferation, were relatively numerous, today little on the subject reaches the newspaper pages, let alone the television screens.

Secondly, under Putin, powerful state structures such as Minatom began to openly proliferate, primarily to China, Iran, and North Korea. These activities are well covered elsewhere.⁸ While high officials usually are behind such activities, they are instances of the blurring of lines between state and private interests, not the outright contraband that many feared during the period of lax controls over regions under Yeltsin.

Some experts have expressed the hope that a more centralized or even authoritarian Russia will deal with proliferation more effectively. However, such an undemocratic Russia could take anti-Western stands and find its ideological soul mates among rogue states. Such a Russia would be more likely to conduct an orderly, government-sponsored proliferation that could be even more difficult to contain than the semi-clandestine, black market variety, which is at least subject to law enforcement activities both domestically and internationally.

The Scope of the Proliferation Threat.

An examination of the sources of proliferation in the Russian regions highlights the multiple sources of danger:

- Nuclear weapons in active service in the hands of the military, primarily the Strategic Rocket Forces. During the Soviet era, 45,000 nuclear bombs and warheads were produced;⁹
- Decommissioned nuclear weapons in storage by the Minatom;
- Stockpile of nuclear materials, such as highly enriched uranium (HEU) and plutonium (altogether 1,200 tons, enough to produce thousands of nuclear devices), stored by Minatom;¹⁰
- Stockpile of low enriched uranium (LEU) and plutonium for nuclear power stations, which can be enriched into weapons-grade materials, also stored by Minatom;
- Nuclear substances used in medicine, civilian research, and other fields, which could be used in fission bombs after enrichment, or in “dirty” radioactive devices powered by regular explosives. These nuclear substances are widely dispersed, mostly unprotected, and difficult to control and inventory;
- Nuclear warhead and missile factories and research facilities, often located in closed or highly restricted “nuclear” and “missile” cities;
- Chemical weapons deployed in the field and in storage;
- Precursors for binary chemical weapons;
- Technology to produce chemical weapons;

- Biological weapons (toxins, bacteria, viruses, and other micro-organisms) stored in research labs in Russia and countries of the former Soviet Union, such as Kazakhstan;
- Technologies to build biological and chemical weapons; and,
- Scientists, engineers, and other experts necessary to build the WMD arsenals.

Since the Soviet Union did not **have** a military industrial complex, but rather **was** one, these sources of proliferation are widely scattered from Moscow to Eastern Siberia. Dispersed throughout eleven time zones, Russia's WMD "crown jewels" are hard to count and harder to keep.

Table 1 indicates closed cities which, in some cases, are not even shown on the map. In other cases, severe restrictions apply to foreigners wishing to visit them.

CITY	SPECIALITY
Sarov	Nuclear weapons development; the Federal Nuclear Center
Snezhinsk	Nuclear weapons development; the Federal Nuclear Center
Trekhgorny	Serial production of nuclear weapons
Lesony	Serial production of nuclear weapons
Zarechny	Chemical industry complex
Zelenogorsk	Chemical industry complex
Ozersk	Chemical industry complex
Novoural'sk	Chemical industry complex
Zhelznogorsk	Chemical industry complex
Seversk	Chemical industry complex
Miass	Rocket Center: Makeev Design Bureau (submarine-launched missiles)
Votkinsk	Votkinsk machine building plant (SS-27 <i>Topol</i> ICBMs)
Korolev	Outer space systems and orbiting stations

Table 1. Specialization of Closed Cities.¹¹

As the Soviet Union collapsed, the Cold War rationale for huge defense budgets and gigantic strategic stockpiles became a legacy of the past and Russian military production plummeted. In 1992, military procurement budgets were slashed by 67 percent.¹² While many Russian towns and regions were dependent upon the military-industrial complex for their welfare, healthcare, and education, since the early 1990s the federal government in Moscow began cutting corners and budgets. The military-industrial complex was told to fund its research and development through raising export revenue. The situation did not change until 1999, when a 50 percent increase in the military budget was announced.

The regional governments never felt ownership over these federally owned and controlled enterprises and closed cities. Regional jurisdiction over these areas was extremely restricted in the Soviet era and remains quite limited today. Still, enterprising and corrupt former governors, such as Leonid Gorbenko in Kaliningrad, Evgeny Nazrdatenko in the Maritime Province (Primorskii Krai), and others, are capable of pillaging the resources of the military-industrial facilities and closed cities to generate a cash flow for their own needs.

Masses of scientists and technical experts—between 60,000 and 70,000 in the Russian nuclear complex alone, according to one U.S. estimate—remained stranded in the closed cities with salaries below Russia's poverty line, or unemployed.¹³ Severe unemployment—up to 50 percent or higher—has devastated many of these towns. Prominent scientists, such as the scientific director of one of the nuclear research centers (Arzamas-16/Sarov nuclear research facility) have even committed suicide.

Living standards have fallen precipitously in those geographical areas that are most capable of spawning proliferation. The national government is often months behind in paying salaries in the military-industrial factories on which whole towns depend. The majority of

scientists and engineers with master's degrees in technical disciplines are paid \$50-\$100 a month. According to a recent study, only 3 percent of technical experts are paid \$100-\$125 a month.¹⁴ Many residents in the military-industrial factory towns have become depressed and desperate, taking to drinking and suffering from other social ills such as drug addiction. The residents in nuclear and missile towns are hobbled by the residency registration (the infamous—and unconstitutional—*propiska* system), which in many cases prevents them from leaving and seeking employment elsewhere.

Even with massive aid from the U.S. Government, sensitive weapons, enriched uranium, and technology are not safe from illicit acquisitions by rogue states or terrorists. According to a report by the U.S. General Accounting Office in February 2001, after spending \$2.2 billion over almost 10 years, only 14 percent of Russia's weapons grade material has been fully secured.¹⁵ Obviously, nuclear safety is not a priority for the Russian government, which, with its increasing anti-Americanism, makes cooperation by Minatom and other official Russian agencies with American-funded programs sponsored by the Departments of Defense and Energy (and with some American nongovernment organizations [NGOs] in Russia), particularly difficult.¹⁶ This is unfortunate, as the Russian federal government has partially abandoned responsibility for maintaining the social infrastructure of the closed cities, leaving it to the regional governments to provide social services, including schools, healthcare, subsidized heat, and housing.

It comes as little surprise that under these conditions of extreme hardship, Russians find ways to cash in on their expertise. For example, the Reutov Mashinostroyenie Science and Production Association in the Moscow *oblast*, and Aksion, a firm from the highly militarized city of Izhevsk (Udmurt Autonomous Republic), are participating in selling to Iran a national satellite communications system with numerous defense capabilities. Other firms

from the regions are participating in transferring SS-4 Intermediate Range Ballistic Missile (IRBM) technology and cooperating with Iran on developing its *Shihab* series IRBMs and intercontinental ballistic missiles (ICBM).¹⁷

Russian government agencies, led by Minatom, facilitated the transfer to Iran of 500 technicians and engineers who work on the Bushehr nuclear reactor project, and cooperated with Iran in bringing other Russian scientists to develop less innocuous nuclear projects. Employment of Russian specialists abroad alleviates the domestic employment situation in closed cities and money-starved military-industrial facilities; earns hard currency for the state; and lines the pockets of corrupt government officials who facilitate such projects.

Russia's Regions: First in Production, First in Commerce.

Since the late 1990s, the Russian regions realized the naivete of passively waiting for handouts from the center. Instead, they are actively seeking markets abroad for the conventional weapons systems they manufacture. For example, firms from cities with strong military-industrial capabilities such as Per'm, Sverdlovsk, Tula, and Izhevsk regularly participate in a huge weapons show in the United Arab Emirates. Alexei Arbatov, Deputy Chairman of the Duma Defense Committee, stated recently that Russian weapons exports to China, India, and Iran are equal to one-half of the Russian military acquisition budget.¹⁸ It is only logical to assume that players from the regions with business and technical expertise are being approached to sell more sensitive systems, including WMD.

Sometimes, cases of outright violation of applicable laws occur, but these are hushed up by the proliferators' friends and associates who work for the security services and other influential branches of the government—often in exchange for a percentage of the profits or an agreed-upon sum of money. Thus, a prominent businessman from Siberia

admitted in an interview with a credible, well-known Russian sociologist, whom the author knows personally, that a large part of his wealth comes from sales of weapons-grade enriched radioactive materials from Krasnoyarsk-26, a well-known closed city, to Middle Eastern countries. FSB, the Russian secret police and successor to the KGB, summoned the researcher and requested that he not publish the story, effectively playing the role of “roof” (criminal protection) for the businessman who admitted violating Russian laws.¹⁹

Instead of participating in proliferation, it has been suggested by American experts that nonproliferation and arms control centers can be created in Russian nuclear cities. Such centers, employing some of the scientists and engineers, could be given the status and authority of proliferation monitors responsible for keeping tabs on Russia’s sensitive exports. Western advisers further suggested that these centers be granted a more prominent role by the Russian government in export control and evaluation, similar to that of U.S. government labs, which are routinely consulted by the U.S. Department of Energy in export control decisions. The center in Snezhinsk already performs such a role.²⁰ However, Moscow has been slow to delegate its controlling authority over sensitive exports to regional players.

Russia’s Regional Rationale for WMD Proliferation.

As time goes by, the Russian regions, military districts, and industrial enterprises are developing direct relations with countries around them. No longer do all economic ties, including those in the military sector, have to be approved by Moscow. Thus, the Russian Far East *oblasts* have developed particularly strong connections with the People’s Republic of China. Tatarstan has made a point of developing bilateral economic ties with foreign countries while paying little attention to Moscow’s wishes. Iran has developed ties to research and academic institutions in Moscow and St.

Petersburg, where the bulk of Iranian students study nuclear physics, military engineering, and space-related disciplines.²¹

Moscow actively pursues high profile contacts with the leaders of rogue states, such as the visit of President Khatami of Iran to Moscow in the spring of 2001, and the “historic” train ride through Russia in August of 2001 by North Korean leader Kim Jong-il. While in Russia, these leaders visit Russian aerospace and nuclear facilities in highly publicized media events. These contacts send a clear message to the Russian regions that rogue countries are respectable military-industrial partners of the Russian Federation.

It is only a matter of time before these foreign parties request their Russian counterparts to provide sensitive technologies, either dual-use or WMD. At the same time, export and customs controls have been rendered ineffective due to pervasive corruption, which allows Russian regional players with pecuniary interest in military-related sales to serve as intermediaries and facilitators in such sensitive transactions. Civilian officials, such as governors, military-industrial “red directors,” and senior military officers have their networks of contacts and patronage. They are in a position to bribe customs officials, obtain export control exceptions and necessary export licenses, or arrange for items to be exported using the ubiquitous Russian military-transport aviation. This air transport system often flies around the world, sometimes on missions having little to do with ferrying Russian troops, such as transporting illegally trafficked arms and drugs.²²

Brain Drain or Brain Upgrade?

The employment situation in the military-industrial complexes in the regions is desperate, and an absolute majority (80 percent) among Russian technical experts in the closed cities would be willing emigrate and work for the military industries of other states.²³ It is worth mentioning

that 64 percent of those prepared to emigrate would be willing to work with “any” organization to achieve their goal, while 24 percent would like to cooperate with a “special state-run agency.”²⁴ This is a strategic threat in itself, and will be treated separately in Chapter 6 of the present volume.²⁵ However, there is another clear and present danger—Russia still boasts an impressive array of colleges and universities which can prepare competent scientists and engineers capable of producing WMD arsenals. These institutions of higher learning, which specialize in nuclear physics and chemistry, ballistics, and rocketry, are located not only in Moscow and St. Petersburg, but also in provincial towns, often those which boast advanced military industrial facilities, as well as in the closed cities.

One of the more prominent among such institutions is the Baltic State Technical University in St. Petersburg, which specializes in ballistic missile design and space technology. Together with ten other institutions, the University was selected for sanctions by the U.S. Government for educating Iranian students. While a professor at the University claimed that he earned 83 cents a day in Russia, Iranians were willing to pay salaries in excess of \$2,500 a month—a fortune for a Russian academic who is close to retirement. Some of the faculty, such as Baltic Technical University Rector Yuri Saveliev, do not hide their anti-American animus.²⁶ The authorities in these institutions of higher learning not only tolerate, but even approve education for students from India, Iran, Iraq, and other problematic states. They also authorize faculty travel to rogue states to teach in technical institutions there.

While, during the Soviet era foreign students from the Third World were provided free education, lodging, and stipends, today these students or their governments pay for their education.²⁷ Thus, the “export of higher education” not only keeps Russian professors employed, it earns otherwise scarce funds for colleges and universities.

There is no unified authority in Russia monitoring the education of foreign students in sensitive fields. When the author recently raised this issue with Russian security experts and government officials, the answer was that the West is educating even more Iranian and other students in physics and sensitive technological fields, and that Russia is no more to blame than the West. According to the Russian Foreign Ministry, “hundreds” of Iranians and Iraqis received advanced degrees in physics and other disciplines in Great Britain, France, and the United States in the 1980s and 1990s. Moreover, according to the Russian Ministry of Foreign Affairs, when Moscow raised this issue with the United States, the answer allegedly was that the United States was a free country, and no academic censorship was tolerated.²⁸ The government of Russia thus refuses to take responsibility for the proliferation of sensitive knowledge from its colleges. This is yet another aspect of proliferation which allows often unstable regimes in developing countries to build up their WMD arsenals.

Conclusions.

The role of Russia’s regions in this process is important, but still secondary when compared to that of Minatom, the Ministry of Defense, and Moscow-based aerospace firms. It is Moscow that sets the pace for sabotaging international efforts against proliferation. While the Russian government maintains that it adheres to international export controls, such as the Missile Technology Control Regime (MTCR), the Nuclear Suppliers Group, and the Australia Group, the reality is different. Russia is exporting sensitive systems and technologies to countries hostile to the United States and her allies, such as China, North Korea, Iran, and Iraq. It is likely that Russia’s military exports of conventional, dual-use, and WMD systems and technology to clients in the Indian subcontinent, East Asia, and the Middle East will grow in the future. These technologies cover the whole spectrum of nuclear, missile, chemical, and elements of biological weapons.

The gap between rhetoric and performance is yawning, while American protests encounter a range of responses which are totally inadequate, from marginal attempts to bring illegal and sensitive military exports under control to outright sabotage and denial.

Russia's regions cannot fail to notice the double standard, which Moscow promotes, rhetorically denying proliferation while pursuing it in practice. It can only be expected that the regions will follow Moscow's lead in the dangerous proliferation game the Russian government is playing. And as long as the regional players keep Moscow's gatekeepers happy by sharing the proceeds, the deadly exports will continue.

It would be in U.S. interests if the Russian government were to offer alternatives to proliferation to the military-industrial enterprises and the military units possessing strategic systems and technology. Military conversion and civilian economic development, possibly involving U.S. firms, would provide an alternative source of revenue to potential and actual proliferators. However, the degree of transparency and reliability of Russian partners has been a problem in past U.S. efforts, and must be held to the highest standard. Safeguards designed to prevent proliferation activities by beneficiaries of U.S. conversion and investment programs must be designed and adhered to.

Finally, information is the key to monitoring and preventing proliferation. While Moscow and St. Petersburg boast ample contingents of American diplomats and consultants, the situation is different outside the capital areas. Thus, the United States might consider increasing its presence and developing contacts in the regions. This could include official U.S. Government representatives and American NGOs. Even more importantly, contacts have to be expanded with potential Russian allies in the government and the NGO communities, who may play a role in curtailing proliferation activities. The official institutions could include governors' offices, the FSB, the General Staff,

military district commanders and staff, and customs officials. The nongovernment community could include the environmentalist movement, the news media, and authorities in higher education.

Only through broad cooperation with Russian institutions can U.S. efforts to stem the flow of proliferation have a chance at succeeding.

ENDNOTES - CHAPTER 3

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19. Source interviewed by author, Washington, DC, June 2001. The source requested anonymity stemming from his fear of invoking more wrath of the businessman in question and the FSB.
20. "Transforming the Russian Nuclear Weapons Complex," p. 12.
21. A Russian aerospace academic expert who requested anonymity, interview by author, New York City, May 2001.
22. Rattray.
23. Tikhonov, p. 11.
24. *Ibid.*, p. 57.
25. Mark Kramer, "Demilitarizing Russian Weapons Scientists: The Challenge," chap. 6 in this volume.

26. Colin McMahon, "For Russia's Top Scientists, Disillusionment and Misery," *Chicago Tribune*, September 9, 1999, reprinted in *Orlando Sentinel*, September 12, 1999, p. G1.

27. Tuition ranges from \$5,000 to \$7,000 a year in "non-technical" universities. Engineering degrees that require extensive lab use may be even more expensive. Professor Z. I. Mishina, Patrice Lumumba University, interview by author, Moscow, May 2001.

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CHAPTER 4

THE HEALTH AND FUTURE OF RUSSIA'S POPULATION

Murray Feshbach

Demographic Trends.

The dynamics of Russian demographic trends will reduce the number of persons born. They will also increase the death rate because of the deteriorating health of the population stemming from major increases in unhealthy children born and subsequent illness and mortality patterns. They portend a decline in the new labor supply. They portend a decline in the number of 18-year-olds available for the draft, and of this declining number, they portend a greater proportion who are poorer and thus unhealthier. Finally, they will affect family formation and dissolution, bringing about declines in total fertility rates through a reduced number of women in the prime fertile ages, which in turn will lessen the potential numbers of births now and into the future. By the year 2050, these dynamics will result in the decline of perhaps one-third (or more) in the population of 144.8 million persons existing at the beginning of 2001.

Sometimes even more apocalyptic projections are found in Russian government and legislative reports or speeches. Russian Labor Minister Aleksandr Pochinok, Russia's current Prime Minister Mikhail Kasyanov, and others speak of sharp declines in the labor supply in the immediate future or several years from now. These trends, combined

with the poor health of newborns, will adversely affect future productivity gains and other economic possibilities. Huge impending increases in mortality from Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) or associated opportunistic illnesses (including tuberculosis [TB], on its own or as a cofactor with HIV/AIDS and others) likely will make for major shifts in the prevailing causes of death. They will also increase mortality while concomitantly lowering average life span. Russian President Vladimir Putin's hope for the immigration to Russia of 500,000 persons per year will not fulfill the requirement of at least 750,000 new births per year simply to sustain the population, let alone provide for growth.

Moreover, cultural impediments to assimilation encountered even by Russians returning from the near abroad (i.e., the former Soviet territories plus the Baltic states) as well as by emigrants from other nationality populations, will be difficult to resolve because of, among other issues, the lack of facilitative funding by federal and local authorities. Such impediments further reduce the potential for a solution through immigration. My projection of 100 million people in Russia by the year 2050 may well be optimistic.

Putin, in his first State of the Union message in June 2000, listed 16 major problems facing the country. Remarkably, and without precedent for a national leader, he cited the demographic problem first. He underscored the net decline in the population (births minus deaths plus or minus net migration) of some 750,000 per year as the basis for his anticipation of the problem. However, he stipulated that economic growth depended on an increase in the number of people. Of importance is not only the gross number, but also the numbers surviving for future fertility (which affect future labor force numbers and the future recruit pool for the military) and the morbidity and mortality patterns existing currently and in the future. My projection of some 100 million by the year 2050 is eclipsed in

terms of apocalyptic magnitude by Nikolay Gerasimenko, the head of the Duma Committee on Health and Physical Fitness, who projects a population of 50 to 75 million by the year 2075. (It is a bit heroic to go out this far into the future.) Russian demographer Sergey Yermakov and a colleague have projected a figure of 70 to 90 million for the year 2050, and the higher figure may be quite reasonable. Projecting the bare numbers, however, is not truly to the point. What is to the point are the implications of these projections for the society, the economy, the military, social stability, and the like.

Official Russian governmental projections for the 20- to 29-year-old female population indicate that the demographic echoes of the decline in the number of births which had begun in 1987 will continue to be felt. This decline will have a dramatic impact on the numbers of women at the prime fertile ages beginning in 2007. The numbers are expected to decline from 12.7 million women at these ages to 7.2 million by the year 2022, and decline even further by 2050 to 6.4 million. Unless fertility increases dramatically, by these numbers alone the likelihood of an increase in population is very, very small. Moreover, as we shall see from the health of the population in general and of females in particular, the negative health trends will clearly affect future fertility in a manner depressing potential growth even further.

Mortality will increase markedly without a doubt as the impact of HIV/AIDS and TB hit in full force beginning in about 2005 and continuing **until** major breakthroughs occur in prevention and treatment, and the necessary funding becomes available. These conditions are not easily met. The numbers of TB deaths alone have increased by 33 and 30 percent in 1999 and 2000, respectively, and promise to increase even more as the amnesty of prisoners with TB, especially multidrug-resistant TB (MDR-TB), continues apace. In this instance, the authorities are damned if they do—for releasing pathogenic individuals—and damned if they don't—by the human rights community because of

incredibly bad conditions in Russian detention centers and prisons. If people were not sick before they entered in jail, it is almost guaranteed they will be sick with TB or other diseases upon release.

The leadership, as one possible solution to the population problem, is currently considering migration possibilities, which also have important military implications for the long run. With net in-migration having peaked at some 800,000 plus in the early 1990s, the net in-migration totaled only about 140,000 in 1999. The first 11 months of 2000 saw a total of 338,000 in-migrants (excluding out-migration), which is one-third of the 1994 figure of 1,140,000. Putin and others have expressed the hope and desire that the number will increase to some 500,000 (on a net basis) from the near abroad. On one hand, a major influx is very unlikely to occur at the desired level in the near term without the push of major economic, ethnic, ecological, or other disasters in these areas. While the Taliban threat to the southern tier is a consideration for these policymakers, it may not come quite to the level of actual war. Emigrants from Afghanistan number about 150,000, but only 500 have formal refugee status.¹ An Armenian earthquake or another Chernobyl event in Ukraine might lead to a large number of migrants, but would likely be only one-time events.

Of greater help would be the improvement in conditions for legal, let alone illegal, migrants already in Russia. Many of these legal migrants have not been supported in the manner promised, nor is it likely that sufficient monies will be forthcoming from the federal or local governments to handle a large increase. Nor will the indigenous populations be so welcoming, given their own problems of resource availability for housing, health care, and jobs. The lebensraum of southern Siberia and the Far East might be a draw for large numbers of Chinese. Currently, estimates of the number migrants there, including Chinese, vary from 700,000 to 1.5 million legals and from 500,000 to 4-5 million illegals.

While China could spare several hundred million (out of a current total population of 1.3 billion), it is doubtful that numbers of this magnitude are realistic. A large number, say 50 million, undoubtedly would be seen as a threat to the national security of the Russian state. Moreover, on the assumption that even a smaller number (perhaps tens of thousands) of young Chinese move into Russia under legal regulation and passports to become permanent residents, would they be subject to conscription? Would they serve? Would they be in sufficient numbers to worry the General Staff about their loyalty? Would they be assigned to sensitive strategic combat arms? Would a professional army (if the government can afford it) obviate large numbers of such citizens for a conscriptee pool? These are all relevant questions, albeit not yet much talked about in the public domain.

While China expert Steven Mosher points out that there are some 5 million permanent Chinese workers and their families resident in the area, it would appear from other evidence that this number is too high.² In January 2001, experts from several Russian government agencies, including the Federal Border Guard Service, estimated that the number of illegal migrants in the previous 5 years from all countries had increased by 10 times. According to their figures, the total number of illegal Chinese migrants approached 750,000, while some 250,000 additional Chinese citizens were officially registered.³ These figures are much lower than Mosher and some others estimate. But the military input continued to warn of the potential for large numbers of “residents” (read the Chinese in particular) to eventually demand “establishment of national autonomies.” Nothing is said in the agency experts’ report about what might be done about it, but the warning is clear.

Such concerns are valid. Valentina Matviyenko, a Deputy Prime Minister for Social Issues, noted the Chinese emigration problem in a speech in the Far East, declaring it a national security threat. Mosher quotes former Russian

Defense Minister Pavel Grachev, who warned as long ago as 1995 that “the Chinese are in the process of making a peaceful conquest of the Russian Far East.”⁴ So have others since, but the recent rapprochement with China may lead to further regularized influxes of aid to the regional economy and perhaps limit the Chinese to this area. Whether it will lead in the future to territorial claims is unclear, but such is not impossible. Will this be another Chechnya? National patriots and various strategic policymakers worry about the loss of territory in Chechnya and its precedent for other regions of the Federation. James Billington, the Librarian of Congress and a renowned Russian historian, in a speech given at the U.S. Institute of Peace in May 1999, is quoted by Mosher as predicting a likely Chinese intervention in “Siberia in the next 10 to 15 years.” The potential is high for this to ensue, but as yet still uncertain.

Russian policy seems to be one of trying to head off a large influx at least. Putin has ordered the formation of a working group to prepare proposals on the regulation of immigration. Their report was due on March 20, 2001. The report’s actual contents are not yet known, but likely will pay much attention (even if not spelled out in any public announcement) to the “Yellow Peril,” to cite a historical and cultural expression of the Russian fear of the Chinese. The potential influx does not appear to have been factored into the migration projections of the State Statistical Agency. In its official report, it projected a figure of 132,000 net in-migrants in 2000 and only 60,600 in 2015.⁵ This figure is very different from the desired figure, according to the Putin policy initiative. Within the regions the Chinese are expected to “occupy,” the Goskomstat projects a decline of 20,600 net in-migrants in the West Siberian Region, 26,900 in the East Siberian Region, and 33,900 in the Far East Region—a decline totaling 81,400, rather than the millions being anticipated. Interesting. One awaits the next year’s Statistical Bulletin on population projections to see if this issue has impacted the technical authorities rather than

simply those political and military operatives concerned with the future of the region.

Health Trends.

Perhaps the most important factor that will affect Russian national security will be the impact of the numbers of deaths projected by Russia's leading epidemiologist on HIV/AIDS. Vadim Pokrovskiy, head of the Federal HIV/AIDS Prevention and Treatment Center of the Russian Ministry of Health, predicts that 10 million or so predominantly 15- to 29-year-old males will begin to die by 2005, definitely by 2010. I fully anticipate that this eventuality, in combination with the deaths and illnesses from other causes, will seriously affect not only the overall demographic trends, but future labor supply and quality, the armed forces' combat capability, family formation, family stability, international status, and on and on. When combined with the very major increases in deaths from TB mentioned previously, the numbers of people affected and concomitant economic costs become staggering. Such costs, when added to other costs to the economy from illness due to poor water, solid particulates in the air, past overuse of pesticides, and chromosomal aberrations causing spontaneous abortions/miscarriages in the so-called military chemical cities such as Dzerzhinsk and Chapayevsk, may become well-nigh intolerable. The growth of drug abuse, the spread of syphilis both in itself and as a precursor to the transition to HIV/AIDS, and the spread of hepatitis C as a cause of death and as another precursor to HIV/AIDS, add even more detriments to the declining health of the population.

The global infectious disease threat emanating from Russia and the region is part and parcel of the strategic implications for other countries, with TB, syphilis (due to the export of women for the sex trade), HIV/AIDS, and possibly malaria affecting near and far distant countries in the future, if not already. Sweden has seen a large,

unexpected growth in syphilis, for example, and a strain of TB is spreading to other countries like that found in Russia, especially MDR-TB. The U.S. National Intelligence Council's report titled *Global Infectious Disease Threats and Their Implications for the United States* issued in 2000, reveals the tip of the likely large iceberg of threats to other countries posed by Russia unless the Russian (and Ukrainian, one can add) health situation improves dramatically. It may be too late to head off these threats, but much can be done to mitigate the regrettable impact.

Where to begin? How will Russian health authorities deal with the simultaneous increases in drug and substance abuse plus the spectacular increase in sexually transmitted diseases, especially syphilis, HIV/AIDS, TB, hepatitis C, and hepatitis B? How will they deal with the low survival rate of 16-year-old males (only two-thirds of the rate of 16-year-old males in the United States who reach age 60), and the increasing proportion of children born unhealthy, who have chronic conditions leaving them impaired for the rest of their lives, especially at age 18, the draft age? Another alarming trend is the declining reproductive health of women and the consequent adverse impact on the health of newborn children. If the leading pediatricians (Tabolin and Baranov, as well as other public health authorities) are correct, only 10 or perhaps 15 percent of children under age 15 are healthy.

Stunting (that is, lower height by age, based on world health standards) and wasting (lower weight by age) are increasing among the young, which of course also leads to ineligibility of 18-year-old males for the draft. The national health indicator averages projected by Tabolin and Baranov need to be supplemented by information on regional health status differentials, with particular attention to the regional sources of recruits for the military. Efforts can then be targeted to improve the overall health status of young persons in the least healthy regions.

The need to improve health conditions is certainly manifest when the head of the Moscow Military District, Mikhail Sorokin, can declare that only one in ten Muscovite males will be available for the spring 2001 draft in his district, a main reason being that 40 percent cannot be drafted because they are too ill and 10-20 percent are draft dodgers (many of whom have “acquired” a certificate affirming mental problems). At the same time, he notes that a whole army company stationed in the Caucasus, 80 persons in all, “really do have mental and psychiatric problems.” Of those actually drafted, many are drug addicts and HIV-carriers, which does not bode well for their active duty performance.

The problem of conscript health can be readily demonstrated by tracking the pattern of syphilis rates, drug abuse, and substance abuse in the last decade. From 1989 to 1998, for example, the rate per 100,000 population of new incidence of syphilis has increased by over thirtyfold, drug abuse by over tenfold, and substance abuse by over 20 percent. Due to changes in legislation which made new syphilis sufferers subject to legal penalties beginning in 1998, the actual number of new syphilis incidence is undoubtedly higher among the conscript age cohort. Especially given the putative major reduction in conscription for the armed forces by 2010, why then does the military not press the Putin government to do more? Given the military’s opposition to a nonconscript force, is the military’s expressed concern strictly for the record? Putin asserted on March 21, 2001, that (as quoted by *ITAR-TASS* the next day) “the navy, air force, missile forces, and some other arms and branches of service are 80 to 90 percent staffed by professionals.” These figures seem high compared to other information and surprising, given demographic and health constraints. Where the funding to pay for an entirely voluntary military would come from is far from clear.

The Educational System.

Disarray in the educational system continues in Russia. Though educational reforms have been implemented, the results are quite uncertain and could negatively affect human capital formation in the future.⁶ This threat to training of current and future generations is due not only to the professional fields that students individually decide to study or not to study, but also the debatable quality of many so-called private schools and college-level institutions. In addition, the health of students as a reflection of society in general and of the youth culture in drug abuse and other socially aberrant behavior, has led to many discussions about the impact on the student population and students' participation in society, if and when they graduate. For example, several reports indicate that St. Petersburg's Education Department, as of March 2001, was worried about the further worsening of school children's health over the previous 3 years, and noted that this generation's health was becoming "significantly worse." In addition, they found that only one of every ten children 10 years of age and under was healthy, and only one in 20 above age 10 was healthy.⁷ If this situation continues, and it likely will, then what does this do to the students' ability to study as well as function in society? Not to be outdone, in a regrettable kind of competition, Leonid Ivanov on the same date indicated that in Tyumen city (located in West Siberia) the city's medical community held a special session to discuss the significant rise in tuberculosis among students of higher educational institutions.⁸ The report asserts that the main reasons for such increases in TB are the "socially aberrant behavior" cited above, as well as "poor nutrition, a poor epidemiological situation, and a genetic predisposition to illness." I do not know how the latter point could be proved, but the other possible underlying causes are widespread and germane to such situations.

Shortages of funding for salaries, for computerization, and the like, which led to strikes by about 300,000 teachers

in 39 regions of the country on February 27, 2001, could well lead to further deterioration of this sector and adversely affect the economy as well.⁹ The potential for economic discrimination is being realized as the shortage of money for education has led not only to the growth of private higher educational institutions, but also to high tuition, leaving behind many who are at the lower end of the economic ladder. Moreover, the share of tuition-paying students has increased markedly since 1995. In 1995, one of every 5 rubles (20 percent) for the sector was paid by so-called “commercial” students; in the 2000-01 school year, 56 percent is derived from private payments. Will talented students be excluded?

Much has been accurately written on the growth of educational achievement by the Russian population, but the future is more tenuous because of the recent volatile and uncertain educational climate. The demographic downturn in the number of births by 50 percent over the past 13 years (1987 to 2000) will provide a much smaller college population beginning in 2015 as students reach 18 years of age. The number of graduates could be too small for the needs of the country, both in absolute terms and in numbers of high-quality students.¹⁰ The past is thus no longer prologue in terms of quantity, and perhaps even in quality, as the confusion in the educational system continues to grow. Attempting to make projections of the number of future scientists in all sectors of the economy is frustrated not only by the declining numbers of potential students, but also by the unknown pattern of fields of study they will choose; ignorance of whether they will join the public or the growing private sector; and lack of certainty as to whether they will reside in Russia, given the alarming trends in the permanent and temporary brain drain. In addition, one would need to know whether graduates will actually do the work they trained for or work in other job slots (for example, many engineers now work in business or finance); what the relative shares of civilian versus military employment will be; and whether students will be subsidized with adequate

stipends in their training (e.g., with college or university fellowships). Such uncertainties make any projection very tentative and likely wrong.

During a talk given by a former Russian Minister of Science, Boris Saltykov, at Georgetown University in 1997—well before much had changed in population numbers, enrollment, expansion of the private educational sector, and announcement of major reforms in the Russian military—he asserted that only about 100,000 scientists were actually active in their science specialties. As reported by Dr. Harley Balzer, head of the Center for Eurasian, Russian, and East European Studies at Georgetown University, Saltykov stated that roughly half of the scientists were employed in civilian research and half in military-related work.

At the same time, the number of researchers among scientific workers (*nauchnyye rabotniki*) was reported by the State Statistical Agency as having dropped sharply over the period 1992-98 (from 804,000 in 1992 to 417,000 in 1998).¹¹ At the same time, the number of admissions to graduate studies and enrollment in their physical-mathematical, chemical, biological, and technical studies programs increased from 6,606 students in 1992 to 14,350 in 1998.¹² This rise in science enrollments is quite contrary to the trend of the overall number of scientists. Graduations over the same period, however, declined from 8,102 to 7,798.¹³ All disciplinary fields cited above declined, except for those students who finished graduate schooling in the biological sciences. This is an interesting development, but too imprecise to indicate anything about where they ended up working.

In sum, then, I do not consider it possible to prepare any serious projections related to science graduates until the educational, employment, military reforms, and/or budget allocations become realistic. This is especially true when these factors are combined with the future demographic and health dynamics. In addition, the difference to date between

words and reality leave too large a gap to hazard anything more than completely untenable estimates and projections.

What is reappearing from the past is a growing “demand” for a return to the system of obligatory assignment upon graduation from a higher educational institution. Putin noted in a speech at Novosibirsk State University in November 2000 that he did not believe in such obligatory assignments because “people have to learn to be self-sufficient.” However, he went on to explicitly exempt state-owned defense enterprises. Since there is a system of government contracts, and it includes a specific table of organization and types of specialists needed to perform the work, free choice allowed since the early 1990s will change. Within 12 to 18 months, the former personnel distribution system for training engineers for the defense industry throughout Russia will be restored.¹⁴ This action would appear to be closely linked to the discussion at a conference held in the Kremlin Palace on December 14, 2000, under the rubric “Professional Engineering-Technical Education and Military Education in the Twenty-First Century.” The title of an article appearing in the military newspaper *Krasnaya Zvezda* on February 16, 2001, is “Engineers Are the Golden Reserve of Russia.” Clearly, the military sector has had trouble retaining young engineer lieutenants and/or recruiting the quantity, and likely the quality, of engineers it needs to fill its national security role. Thus, freedom of choice for college and university engineering graduates will be restricted. The pre-1990 rule for a 3-year period of obligatory time in the assigned job is not specified in the source, but likely will be at least that amount of time when the details emerge from this initiative.

Implications for the Future: A Brief Summary.

The relation between demography and health trends is not very positive for productivity gains leading to economic growth or for enhanced national security of the state because the limits engendered by an unhealthy and much

smaller population impact the following generations. Denial by some members of the establishment in Russia continues to this day. Coming out of a meeting of the Board of Directors of the Ministry of Health of the Russian Federation on March 20, 2001, Minister of Health Shevchenko is reported to have affirmed that the health concept adopted 3 years earlier had been “basically realized.” Yet, contradictorily, he is then said to have added, “But the health situation has worsened.” I would have thought these two statements are at odds with one another—but he apparently did not. However, according to the same report, during an unscheduled visit, Vice Minister for Social Affairs Valentina Matviyenko issued a “short unplanned statement” to the effect that the “budget allocation for the health sector is declining, and this affects the situation as a whole.”¹⁵ Moreover, she went on to say that “tuberculosis is growing as a threat, and HIV-infections are threatening to grow out of control.” How then could Shevchenko affirm that the “health component is insignificantly small in the demographic problem.” He suggested that only “war, repression, and prisons” are affected by the “demographic crisis.” Prisons are crucial, obviously, but certainly TB, HIV and its trends, and reproductive and child health remain vital considerations in any discussion of the demographic crisis, to use his term.

As to which of the two trends—demographic or economic—will become ascendant, it is impossible to predict with certainty, but I expect the demographic (read health and educational problems, as well) to nullify any potential economic progress.

I have not addressed the casualty threats from remaining nuclear, biological, and chemical weapons, or from terrorism, or from thefts of associated materials for use by individuals internally or externally, by organizations, and/or by governments, because they are beyond the scope of the present chapter. However, they should not be omitted from a full analysis of health hazards as well as security issues facing Russia.

ENDNOTES - CHAPTER 4

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3. See the Military News Agency internet site, <http://www.militarynews.ru>.
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5. *Predpolozhitel'naya Chislennost' Naseleniya Rossiyskoy Federatsii do 2016 Goda (Statisticheskiy Byulleten')* (Hypothetical Size of the Population of the Russian Federation Until 2016: Statistical Bulletin), Moscow, 1999, p. 144.
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10. Assuming a lognormal distribution.
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CHAPTER 5

NEW METRICS FOR DENUCLEARIZATION

Thomas B. Cochran

Introduction.

The legacy of Cold War nuclear weapons programs in the United States and Russia represents serious continuing threats to each country's national security. Today, the primary danger to the United States from Russia's possession of nuclear weapons is not from a deliberate attack, but from a mistaken, unauthorized, or accidental missile launch. In addition, the Russian nuclear weapons program—more so than that of the United States—represents a continuing global proliferation threat as well as a public health and environmental hazard. The proliferation threat stems from the facts that Russia (1) is still producing and separating plutonium; (2) has some 15,000 to 20,000 assembled nuclear weapons and about 1,700 metric tons of separated nuclear weapon-usable fissile materials (much of it under inadequate security); and (3) lacks alternative jobs to offer the 67,000 workers who live in ten closed nuclear cities. Russia suffers from the most severe environmental pollution of any country and lacks the funds to clean it up. A failing economy and widespread corruption compound these problems. To reduce these risks, the United States and Russia have been engaged in a variety of programs that can be loosely described as a program of "denuclearization."

In the first part of this chapter, I examine a new approach for establishing priorities and measuring progress in denuclearization and nonproliferation. The second part addresses a new method of funding a portion of the denuclearization effort.

The Denuclearization Metric.

“Denuclearize” can be defined as either removing nuclear arms **from** an area or prohibiting the presence/use of nuclear weapons/arms **within** an area. It is the first of these two definitions that will mainly concern us here. A limitation of our definition, of course, is that it does not reflect the threats represented by partially assembled nuclear warheads, stockpiles of nuclear materials, or nuclear weapon production technologies and nuclear weapon expertise.

A useful, albeit narrow, technical metric for measuring progress in denuclearization would be a curve plotted relative to two axes, displaying the cumulative number of nuclear weapons that a state could launch or use as a function of the time it would take to use them (setting aside employment policy considerations). By this metric (see Figure 1), denuclearization is the process of reducing the area under the curve and shifting the curve and the area under it to the right. This is tantamount to reducing the number of nuclear warheads, reducing warhead potential, and increasing the time to achieve “use ready” status (e.g., to render strategic weapons ready for launch), or operational status of nonstrategic weapons. One can compare various denuclearization strategies by examining how the curve shifts over time under various proposals.

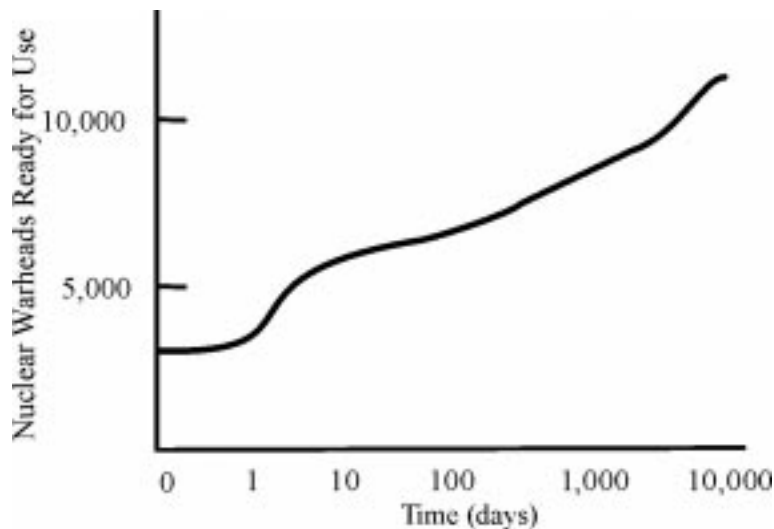


Figure 1. Notional representation of the number of nuclear warheads that can be brought to launch ready or use ready status as a function of time.

Now look at Figure 2. The same metric can be used to describe the status of nonweapon states in terms of how long it takes each state to acquire nuclear weapons and the state's capabilities to produce and field nuclear weapon arsenals. By definition, these states have no nuclear weapons at present, so the curves representing their respective weapon potential intersect the horizontal axis (representing number of days) rather than the vertical axis (representing number of nuclear warheads). But the nonproliferation objective is the same as for weapon states, that is, to shift the curves to the right. In Figure 2 the international safeguards "timely warning criterion" is met for a given country only if the time period represented by the distance from the origin to the horizontal axis intercept is sufficiently long for the international community, through diplomatic pressure and sanctions, to prevent the state from acquiring nuclear weapons should the state seek such a an option. In a non-nuclear world, all states would be represented by curves similar to those depicted in Figure 2.

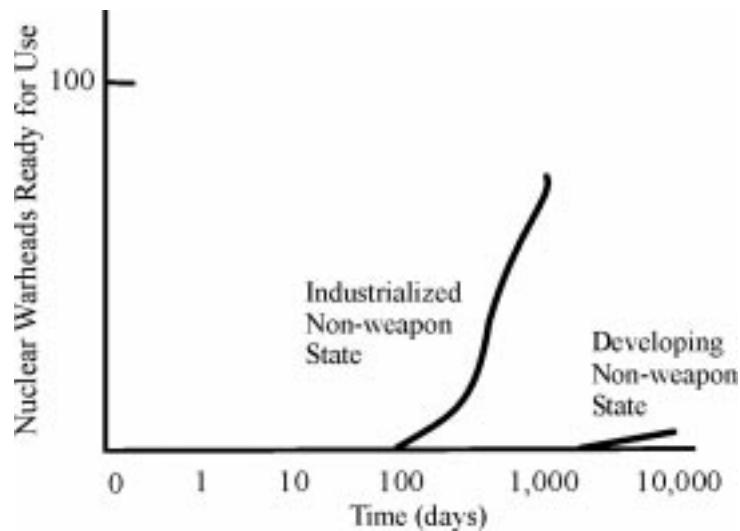


Figure 2. Notional representation of the number of nuclear warheads that can be produced and brought to launch ready or use ready status as a function of time.

To avoid having to determine and address a state's capability to fabricate nuclear warheads and delivery vehicles, the nonproliferation metric in Figure 2 can be usefully simplified by changing the vertical axis so as to portray "quantity of weapon-usable fissile material" in place of "nuclear weapons ready for use." Or an agency like the International Atomic Energy Agency (IAEA) might plot "Significant Quantities of Fissile Material," to use a different example.

Returning to Figure 1, to accurately plot such a curve one needs to know the number of warheads and the amounts of fissile materials in various categories of warheads, warhead components, and fissile materials. For example, today the United States has over 2,600 warheads on "launch ready" alert that can be launched in a matter of minutes. Within a few days the United State could bring its strategic forces to "Generated I" alert status by moving some five or so additional submarine-launched ballistic missiles (SLBMs)

on station, thereby adding another 960 or so warheads to use ready status.

One can continue this exercise by including the strategic bomber force, nonstrategic bomber weapons, and hedge weapons, some of which would take progressively longer to bring to launch ready status. It would take even longer to activate inactive warheads, still longer to reassemble pits and canned subassemblies into usable warheads, and even longer still to manufacture new warheads from fissile and other materials.

Table 1 ranks various categories of warheads, warhead components, and fissile materials in terms of how long it would take to attain use ready status. As seen from the table, denuclearization is more complicated than just eliminating nuclear weapons. Denuclearization is the process of moving warheads and materials from categories high on the Table 1 list to categories lower on the list. Moreover, movements between any two categories are not of equal worth. For example, when there are numerous warheads in the higher-ranked categories, as is the case today in the United States and Russia, then progress in moving fissile materials down through the lower ranks will not substantially alter the risks associated with a state's use of nuclear weapons. In general, the "worth" of each step becomes progressively less as one moves down through the list of categories in Table 1. In order to make the area under the curve more representative of the "worth" of the weapons and weapon materials, I have selected a logarithmic scale for the horizontal axis in Figures 1 and 2, meaning that the number of days increases exponentially with each incremental move to the right.

RELATIVE EMPLOYMENT PREPARATION TIME

Launch Ready Alert Level Warheads
Warheads Added by Bringing Forces to Generated Alert Status
Other Deployed Warheads
Non-Deployed Warheads in the Active Stockpile
Inactive Stockpiled Warheads
Warheads Awaiting Disassembly
Stored Pits and Canned Subassemblies
Plutonium (Pu) and High-Enriched Uranium (HEU) in Metallic Form
Pu and HEU Oxides and Other Chemical Forms
Pu and HEU in Fresh Fuel Assemblies
Pu and HEU in Spent Fuel Assemblies
Low-Enriched and Natural Uranium
Spent Fuel in Geologic Repositories
Uranium Ore

Table 1. Warheads, Warhead Components, and Fissile Material Stocks Ranked Approximately According to the Time It Takes to Achieve Launch Ready Warhead Status.

Thus far we have discussed denuclearization in the context of reducing the risks associated with a weapons state's use of nuclear weapons, either deliberately or accidentally. We also want to reduce the risk of nonweapon states and nonstate entities acquiring nuclear weapons, for example, by diverting nuclear weapons, weapon-usable materials, or expertise from a weapon state. The proliferation risks associated with a weapon state's nuclear weapons program can be reduced by the following measures:

- Reducing the total stocks of weapon-usable nuclear materials available for diversion;

- Improving the security of existing stocks of fissile materials; and/or
- Reducing the likelihood of transfer of nuclear expertise for unauthorized purposes.

Note that reducing the total stocks of nuclear weapons and weapon-usable nuclear materials reduces both the weapon state threat and the nonweapon state threat associated with these materials. The denuclearization metric therefore has utility in measuring progress in reducing the risk of diversion. The denuclearization metric, however, is less useful for establishing priorities for measuring progress in improving security of fissile material or reducing the likelihood of transfer of nuclear expertise, except that taking steps to move the curve down and to the right does lessen the prospect of readily available warheads and materials and it potentially leads to a lessening of expertise.

U.S. Denuclearization Priorities.

The United States is pursuing several somewhat independent denuclearization and nonproliferation efforts in cooperation with Russia: (1) nuclear arms reduction negotiations—the START II/III treaty negotiation process, which the Bush administration may replace by unilateral actions; (2) the START I verification program; (3) the Cooperative Threat Reduction Program (so-called “Nunn-Lugar”), under which launch vehicles are dismantled; (4) the 500 metric tons highly-enriched uranium (HEU) purchase agreement, under which HEU from weapons is blended down into nonweapon-use fuel for power reactors; (5) the joint U.S.-Russian plutonium disposition program; and (6) various efforts to improve the security of existing stocks of nuclear weapons and fissile materials.

In broad terms, there are several shortcomings with these efforts. First, the six program elements were not

developed as part of a comprehensive integrated package. The United States has neither a comprehensive nor an integrated strategy for achieving progress in denuclearization. The United States attaches high priority to efforts that have the lower worth, e.g., the plutonium disposition program, and little priority to some efforts that have a higher worth, e.g., removing warheads from launch ready status (“de-alerting”), and dismantling canned subassemblies. Moreover, the United States attaches little priority to achieving a data exchange with Russia in order to ascertain the number of nuclear warheads, warhead components, and fissile material stocks in the various categories in Table 1. The United States does not know, within plus or minus a few thousand, how many tactical nuclear warheads Russia has retained in its arsenal. Without a reliable data exchange, the United States cannot measure or verify progress in denuclearization.

Let us now turn to an analysis of some of the specific ongoing U.S.-funded denuclearization and nonproliferation initiatives in Russia.

U.S. Nonproliferation Initiatives in Russia.

Since the collapse of the Soviet Union almost a decade ago, the U.S. Government has initiated a variety of Russian-based programs with the following objectives:

- Improve the security of existing stocks of fissile materials in Russia to reduce the likelihood of theft and unauthorized use;
- Reduce the total stocks of weapon-usable nuclear materials; and,
- Provide alternative employment opportunities to nuclear, chemical, and biological weapons experts to reduce the likelihood that they would sell their expertise abroad.

In addition, the ongoing programs provide transparency with respect to nuclear weapon and other activities in Russia.

The United States has been spending about \$500 million a year on the Russian safeguarding effort. The Bush administration has initiated a “comprehensive review” of these programs. I do the same here, beginning with a brief summary of the principal ongoing initiatives.

Improving the Security of Fissile Materials.

There are several ongoing efforts, the main ones being as follows:

- **Russian Fissile Material Storage Facility at Ozersk.** Provides assistance in the construction of a large storage facility at Ozersk (Chelyabinsk-65) and construction of 10,000 special fissile material containers for use in this facility. The construction of the first of two wings is almost complete, and loading of this wing is scheduled to commence in FY2002. When both wings are complete, the facility will hold the fissile materials from approximately 12,500 warheads. Construction costs of the first wing were capped by Congress at \$460 million. Funded by DOD’s Defense Threat Reduction Agency under the Cooperative Threat Reduction (CTR) budget (FY2001, \$57.4 million);

International Materials Protection, Control, and Accounting (MPC&A). This is a program to install improved security systems at civilian nuclear sites, naval fuel and weapon sites, and nuclear weapon laboratory sites, and to consolidate nuclear materials at fewer sites. Founded by Department of Energy/National Nuclear Security Administration (FY2001, \$169.7 million; FY2002, \$138.8 million);

Improve Security at 12 GUMO Nuclear Weapon Storage Sites. Provides assistance to the Russian Ministry of Defense’s 12th Main Directorate (12th GUMO) to

improve security at nuclear weapon storage sites (other than Russian Navy sites). Funded by DOD under the CTR budget (FY2001, \$89.7 million);

Improve Nuclear Weapon Transportation Security. Provides assistance to the Russian Ministry of Defense's 12th GUMO to improve nuclear weapon transportation security. Funded by DOD under the CTR budget (FY2001, \$14 million); and,

Pit Conversion and Fissile Material Packaging. Provides assistance to the Russian Ministry of Defense's 12th GUMO to facilitate packaging of fissile materials from dismantled warheads for subsequent shipment to and storage at the storage facility at Ozersk now under construction. Funded by DOD under the CTR budget (FY2001, \$9.3 million).

These five initiatives all deserve support. A problem, however, with respect to all of them is that the United States (and possibly Russia) does not know how many nuclear weapons and how much fissile material exist in Russia, and the United States does not know where much of it is stored. The United States has failed to make a high priority effort to secure a bilateral data exchange on weapon and fissile material inventories.

Referring back to the categories in Table 1, we see that the United States has placed relatively high priority on storage of plutonium and HEU in metallic form (i.e., at Ozersk), but there is no joint program associated with some efforts described in Table 1 that are of higher worth, e.g., accelerating disassembly of the warheads.

Reducing Stocks of Weapon-Usable Nuclear Materials.

The principal ongoing efforts here are as follows:

- **Highly-Enriched Uranium (HEU) Purchase Agreement.** A U.S.-Russian agreement whereby 500

metric tons of HEU from Russian weapons are to be blended down into low-enriched uranium (LEU) for use as power reactor fuel, and the purchase by the United States of the separative work unit (SWU), or enrichment values, of the LEU. To date, just over 100 metric tons of the 500 have been sold and delivered to the U.S. Enrichment Corporation (USEC), the government appointed executive agent for the HEU purchase agreement. DOE provides funds for implementation of transparency agreements associated with the blend-down of HEU into LEU in Russia (FY2001, \$14.6 million; FY2002, \$14.0 million);

- **Plutonium Disposition.** Under this program, 34 metric tons of weapon-grade plutonium are to be eliminated by both Russia and the United States by first converting it to mixed plutonium oxide and uranium oxide (MOX) fuel and then using the MOX fuel in nuclear power reactors, thereby converting it into spent reactor fuel. Funded by DOE/National Nuclear Security Administration (FY2001, \$56.5 million; FY2002, \$62.0 million; less use of prior years' balances, the totals are reduced to: FY2001, \$41.5 million; FY2002, \$20.0 million); and,

- **Plutonium Production Reactor Core Conversion.** An effort designed to assist Russia in converting the three remaining dual-purpose (plutonium and energy production) reactors to reduce or eliminate weapon-grade plutonium production. There are three options under consideration: converting the reactor cores to LEU fuel; converting them to HEU fuel; and replacement of the reactors with non-nuclear power plants. Funded by DOD's Defense Threat Reduction Agency under the CTR budget (FY2001, \$32.1 million).

There are two problems with the HEU Purchase Agreement that should be rectified. First, the U.S. Government has turned this program over to what is now a private company, the U.S. Enrichment Corporation

(USEC), which serves as the Government's executive agent for implementing the program. Under this arrangement, to the detriment of the program, the profit motive of USEC has become a higher priority than the denuclearization objective of the United States. Second, the United States does not know the quantity and disposition of Russian HEU, so the worth of this effort is difficult to gauge.

The plutonium disposition program is an example of misplaced priorities. It would be far more productive for the United States to spend its diplomatic capital and taxpayer funds on converting plutonium pits into plutonium "pucks" (unclassified shapes) and putting the plutonium pucks under international safeguards, certainly more productive than trying to fund and construct a Russian MOX fuel fabrication plant. The proposed MOX plant will not even keep up with the current rate at which Russia is separating new plutonium from dual-purpose plutonium production reactors and from commercial power reactors. Moreover, Russia has so few VVER-1000 reactors, it cannot convert more than a few metric tons of plutonium into spent fuel annually, even if a MOX fabrication plant were built in Russia. Finally, a Russian MOX program will likely increase proliferation risks in the long run.

The Plutonium Production Reactor Core Conversion program has been stymied by the failure of Russia and the United States to reach agreement on what the end point of the conversion effort should be—use of LEU or HEU fuel, or replacement of the three reactors. The proposal to convert the reactor to HEU fuel is ill-conceived in that the proliferation risks associated with the HEU fresh fuel are no less than the risks associated with the separated plutonium.

Alternative Employment Opportunities for Nuclear Workers.

The principal ongoing efforts here are as follows:

- **International Science and Technology Center (ISTC).** This is an intergovernmental organization established in 1992 by agreement between the European Union, Japan, the Russian Federation, and the United States. Headquartered in Moscow, ISTC provides weapons scientists from CIS countries with opportunities for redirecting their scientific talents to peaceful science. In 1999 there were 201 projects covering 17,815 participants funded at \$42.6 million, with the United States contributing \$13.2 million. The participants worked an average of 63 days on the ISTC funded projects, so the participation was more like 4,800 full-time equivalents. The ISTC paid the 17,815 project participants \$22.6 million in grant money, which works out to an average salary of about \$4,700 per year (\$20 per day).

- **Initiatives for Proliferation Prevention (or IPP, formerly called the Industrial Partnering Program).** This is a program to facilitate and promote employment and economic development opportunities for displaced nuclear weapon scientists and engineers. Efforts focus on cooperative projects involving DOE laboratories and research institutes in Russia, Ukraine, Kazakhstan, and Belarus. Every dollar the U.S. Government provides for a project is matched by industry. The federal contribution is funded by DOE/National Nuclear Security Administration (FY2001, \$24.1 million; FY2002, \$22.1 million);

- **Nuclear Cities Initiatives (NCI).** This is a program of cooperation with the Russian Ministry of Atomic Energy (Minatom), commercial entities, and local and state governments to create civilian ventures in one of the ten closed nuclear cities. Funded by DOE/National Nuclear Security Administration (FY2001, \$26.6 million; FY2002, \$6.6 million).

While these three initiatives have not prevented senior Minatom and Russian Institute officials from providing nuclear weapon related assistance to Iran, they are

nevertheless useful and cost effective. This is particularly the case with respect to the ISTC and IPP programs. The NCI initiative is too new to have established a track record, but it will likely suffer from the facts that (1) DOE and the national laboratories have very limited expertise in commerce, and therefore will have difficulty in identifying potential commercial markets; and (2) the business must be successful, particularly in Russia. All three programs, ISTC, IPP and NCI, have effective measures in place to prevent the misallocation of funds, and all provide useful transparency at institutes where funded research is conducted. Looking beyond the next few years, there are better ways to accomplish the objectives of these programs. As an alternative, the United States should consider financing a program that encourages early retirement of Russian workers.

All three ongoing programs cited above require the identification of a scientific project, or alternative employment opportunity, before the Russian participant can receive financial support. None provide an incentive for Minatom or its workers to shut down entire weapons-related facilities, e.g., a fuel reprocessing or chemical separation plant. To provide such an incentive, the United States should consider establishing a trust fund to pay for the early retirement of Russian nuclear workers. The workers at targeted facilities would take early retirement and be permitted to pursue other nonweapons employment. The trust would not be required to provide alternative employment projects as a condition for shifting from weapons work.

The ten closed cities¹ that host most of the Russian nuclear weapons program have a total population of about one million people. The total number of weapons workers in these cities in 2000 was some 60,000-67,000, a number that is projected to drop by about 50 percent over the next 5 years as Minatom downsizes its nuclear weapon work force.² If the 32,000 person projected work force (or projected work force reductions) were to be underwritten at the rate the ISTC

paid project participants in 1999 (\$4,700 per year), the total cost would be \$150 million per year. Comparatively, this represents 2.8 percent of the FY2002 DOE Stockpile Stewardship Program budget.

Funding Denuclearization.

In January 2001, a DOE-appointed nonproliferation task force co-chaired by Lloyd Cutler and former Senator Howard Baker, Jr., concluded that:

Current nonproliferation programs of the Department of Energy, the Department of Defense, and related agencies have achieved impressive results thus far, but their limited mandate and funding fall short of what is required to fully address the threat. . . . The current budget levels are inadequate and the management of the U.S. government's involvement is too diffuse.

A private initiative called the Nonproliferation Trust, Inc. (NPT) offers an alternative source of substantial funding to augment U.S. Government-funded security efforts. Since Western governments have demonstrated they are unwilling to invest the necessary resources to adequately address the security problems in Russia, NPT's goal is to step into the breach by augmenting government funds with private capital associated with nuclear spent fuel management.

The Non-Proliferation Trust is a Delaware corporation whose purpose is to foster global nuclear nonproliferation plus environmental and humanitarian initiatives. NPT proposes to raise \$15 billion by taking title to 10,000 metric tons of foreign (non-U.S. and non-Russian) nuclear spent fuel and storing it in Russia. The project would require \$3.45 billion to safely manage the spent fuel, an amount which could cover purchasing spent fuel storage casks, constructing and managing a dry cask storage facility, and transporting the fuel. The project would allocate more than 75 percent of the revenues—the remaining \$11.55

billion—to nonproliferation, environmental, and humanitarian causes in Russia.

Environmental Cleanup	\$ 3.0 billion
Fissile Material Security	1.5
Geologic Repository Siting and Construction	1.8
Spent Fuel Escrow/Repository	0.5
Alternative Jobs for Nuclear Weapon Workers	2.0
Regional Economic Support	0.5
Humanitarian (pensioners and orphans)	2.25
Total: \$11.55 billion	

NPT currently plans to allocate the \$11.55 billion as follows:

To prevent the misuse of these funds, the monies would be managed by three U.S.-based charitable trusts: the Minatom Development Trust, the Russian Environmental Trust, and the Russian Humanitarian Trust.

The NPT project is still in the conceptual stage. Much work and additional negotiations are required to develop it more fully. Moreover, the project cannot go forward unless there is an agreement for cooperation on nuclear matters between the United States and Russia.

ENDNOTES - CHAPTER 5

1. Sarov (Arzamas-16), Snezhnisk (Chelyabinsk-70), Ozersk (Chelyabinsk-65), Sversk (Tomsk-7), Zheleznogorsk (Krasnoyarsk-26), Novouralsk (Sverdlovsk-44), Zelenogorsk (Krasnoyarsk-45), Lesnoi (Sverdlovsk-45), Trekhgornyi (Zlatoust-36), Zarechnyi (Penza-19).

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CHAPTER 6

DEMILITARIZING RUSSIAN WEAPONS SCIENTISTS: THE CHALLENGE

Mark Kramer

The aim of this chapter is twofold: (1) to explore the threat of strategic proliferation posed by former Soviet scientists, engineers, and technicians who design, build, and maintain weapons of mass destruction (WMD); and (2) to consider whether large-scale immigration of such workers to the United States over the next 10 to 15 years could help diminish that threat.

The chapter is divided into seven sections. The first reviews the size of the Russian nuclear, chemical, and biological weapons complexes and the approximate number of scientists and engineers employed by each. The second discusses the actual and potential brain drain from the Russian scientific community and defense complex to foreign countries after 1991. The third analyzes trends regarding the entry of former Soviet scientists into the United States in the 1990s. Whereas only a relatively small number were admitted as immigrants, a larger, though still not huge, number were allowed in for temporary work or exchanges. The fourth briefly explains why U.S. Governmental and private efforts to employ Russian WMD scientists and engineers on civilian research projects within Russia are likely to have only a negligible impact on the longer-term threat of strategic proliferation. (In an Appendix to this chapter, I have prepared a detailed analysis supporting this conclusion.) The efficacy of these

programs is limited not by any inherent shortcomings—though these have clearly played some role—but rather by the sheer magnitude of the problem. Even if the programs were perfectly designed and implemented, their net contribution in all likelihood would be meager.

The fifth shows why the private sector in Russia has not been able to absorb more than a relatively small proportion of former WMD personnel, a situation that is likely to continue indefinitely unless much more drastic economic changes take hold. The findings in this section reinforce the conclusions of Matthew Partan in Chapter 7 of this book. The sixth discusses the Russian government's recent efforts to curtail the brain drain from scientific research institutes and defense enterprises, particularly the WMD complexes. On one hand, the government has provided increased funding for science and has taken other steps to improve the conditions for research on nuclear weapons and other military-related technologies as well as civilian scientific projects. These measures have been designed to retain existing personnel and to attract new talent, especially younger scientists and engineers. On the other hand, the government has sought to tighten laws and decrees that severely restrict foreign travel by individuals who have had access to "state secrets" and to restore Soviet-era curbs on contacts between Russian and foreign scientists. Such restrictions, though not yet fully implemented, will inevitably hinder prospective attempts by Russian WMD personnel to immigrate to the United States.

The concluding section of the chapter considers whether the threat of strategic proliferation can be countered over the long term by encouraging the immigration of thousands of Russian WMD scientists and engineers to the West. A solution of this sort would be highly desirable, but the feasibility of it is open to serious doubt. Rather than pursuing what would likely be a futile quest, the United States would benefit most by promoting large-scale exchange programs for Russian high school students. Such

exchanges would be eminently feasible and would have a positive long-term effect on the human dimension of the strategic proliferation challenge.

For reasons of space, documentation for this chapter has been omitted from the published version. An expanded and fully documented version of the chapter is available from the author upon request.

RUSSIAN WMD EXPERTS

This section discusses the size of the Russian nuclear weapons complex and then does the same for Russia's chemical and biological weapons industries.

Nuclear Weapons Complex.

When the Soviet Union collapsed in late 1991, it left behind an enormous infrastructure for the development, design, and construction of nuclear weapons. The Soviet Ministry of Atomic Power and Industry had overseen more than 150 enterprises and 1.1 million employees. From the 1940s through 1991, the weapons complex produced a total of more than 1,200 metric tons of highly enriched uranium and 150 metric tons of plutonium for use in some 55,000-60,000 nuclear warheads and bombs. The design and construction of nuclear weapons had long centered around ten "closed cities" (known in Russian as *zakrytye administrativno-territorial'nye obrazovaniya*—closed administrative-territorial entities) that were completely off-limits to the public, geographically isolated (in most cases), and omitted from public maps: Sarov (Arzamas-16), Snezhinsk (Chelyabinsk-70), Ozersk (Chelyabinsk-65), Seversk (Tomsk-7), Zheleznogorsk (Krasnoyarsk-26), Novouralsk (Sverdlovsk-44), Zelenogorsk (Krasnoyarsk-45), Lesnoi (Sverdlovsk-45), Trekhgornyi (Zlatoust-36), and Zarechnyi (Penza-19). Different areas of defense-related research were explored at the ten cities, which employed a total work force of some 750,000. Roughly 150,000 to 160,000 of these workers were involved in the

design, manufacture, and testing of nuclear explosives. Sarov and Snezhinsk were the sites of the main weapons design bureaus, and Sarov also contained the Avangard weapons assembly plant. Other key weapons assembly facilities were located in Lesnoi, Trekhgornyi, and Zarechnyi. The remaining closed cities were responsible for producing weapons components and fissile material.

The Russian nuclear weapons complex continued to function at a robust level after 1991, despite a sharp reduction in the operating budget of the Russian Ministry of Atomic Energy (Minatom). As of early 2001, the nuclear weapons research institutes and manufacturing facilities still employed 125,000 to 130,000 people, a work force only slightly smaller than during the Communist period. Of these, at least 75,000 were working full-time on weapons design, production, and testing, and the remainder were responsible for support and administrative tasks. Even though precipitous cuts were made in the procurement of Russia's conventional military hardware (85-90 percent), the nuclear weapons industry was accorded a relatively privileged status. The continued presence of many thousands of former Soviet nuclear weapons specialists in the ten closed cities impeded Minatom's faltering attempts to restructure and scale back the nuclear complex. The ministry reported in the summer of 1999 that some 30,000 to 50,000 excess employees could not find alternative jobs if they were laid off. Although Minatom has claimed that it wants to reduce its current work force by almost two-thirds as of 2004, there is as yet little reason to believe that tens of thousands of excess employees will simply be laid off.

Overall, then, the nuclear weapons complex has experienced less disruption than one might have expected. The two key nuclear weapons design centers—the Scientific-Research Institute of Experimental Physics (VNIIEF) at Sarov and the Scientific-Research Institute of Technical Physics (VNIITF) at Snezhinsk—have maintained large staffs of scientists, engineers, and technicians. According to official figures, VNIIEF as of 1999

still employed as many as 24,000 people, while VNIITF still employed 11,000, nearly the same number who worked there during the 1980s. (The institutes were formally designated “federal nuclear centers” in 1995.)

The relatively modest personnel cuts in the former Soviet nuclear weapons complex have failed to mirror the huge reductions in the conventional forces and defense industries of Russia and other former Soviet republics. In that sense, as both private and governmental organizations in the West have stressed, Russia has been notably reluctant to scale back its nuclear weapons industry from the Cold War period. Scientists in the Russian nuclear weapons complex continue to refine existing weapons and components and to conduct research on new technologies for future weapons.

The precise number of nuclear weapons employees in Russia who possess specialized knowledge of critical weapons designs or technologies is unknown, but the most reliable evidence suggests that some 2,000 to 4,000 senior nuclear scientists and engineers have been directly involved in bomb design, production, and disassembly, and another 10,000 to 15,000 senior experts have been performing vital ancillary functions connected with nuclear weapons production. In January 1992 then director of the Russian nuclear weapons program Viktor Mikhailov declared that 2,000 to 3,000 of the roughly 15,000 senior nuclear weapons scientists in Russia were engaged in activities “of paramount importance involving sophisticated technologies.” He repeated these statistics in numerous other interviews over the next several years. The same figures were cited in mid-1996 by Vladislav Mokhov, a senior official at the Sarov federal nuclear center. Estimates by the U.S. Department of Energy (which oversees contacts with the former Soviet nuclear weapons laboratories) and other U.S. Government agencies are very similar to Mikhailov’s and Mokhov’s figures. A classified National Intelligence Estimate prepared by the U.S. intelligence community in the early 1990s indicated that around 2,000

senior specialists throughout the former Soviet Union possess “intimate knowledge of nuclear weapons design.” Likewise, a report issued by the U.S. Congressional Budget Office in mid-1999 noted that, although 20,000 senior “nuclear scientists and workers” in Russia pose “proliferation risks,” only a relatively small fraction of these (perhaps 15 to 20 percent) are involved in the most sensitive work.

These various estimates confirm that the number of senior nuclear weapons experts possessing truly sensitive information is a much smaller subset of the total population of scientists and engineers in the former Soviet nuclear weapons complex. The number of employees who pose a significant, but less acute, secondary threat is considerably larger, but still meager in comparison with the size of the post-Soviet defense complex, which employs at least a few million workers. Hence, the number of Russian nuclear weapons experts who could be recruited by Third World countries for help on a fledgling weapons program is far smaller than some Western observers had originally feared. At the same time, the pool of senior weapons scientists is large enough to keep Russia’s nuclear complex operating indefinitely, provided that adequate resources are available.

Chemical and Biological Weapons Complexes.

The Soviet Union amassed a stockpile of 40,000 metric tons of chemical munitions, the largest in the world. These weapons were developed and manufactured at 24 separate facilities, including key production centers in Dzerzhinsk, Novocheboksarsk, Slavgorod, Volgograd, and Zaporozh’e. At the end of 1991, Russia inherited these facilities along with thousands of scientists, engineers, and technicians employed by the Soviet chemical weapons complex. A study released in September 2000 by Republicans in the U.S. House of Representatives claimed that “tens of thousands of scientists and technicians” were working in Russian

chemical weapons facilities, but this estimate seems too high. Although the precise number is not known, most evidence suggests that several thousand scientists—perhaps ten thousand in total—are still working in Russia’s chemical weapons complex. This figure is very large by world standards, but it is much smaller than the number of scientists and technicians employed in the Russian nuclear and biological weapons complexes.

The Soviet biological weapons program, code-named Enzyme, was shrouded in secrecy from the time it was launched in 1973. The Soviet Politburo, headed by Leonid Brezhnev, issued a highly classified decree establishing Biopreparat, a state pharmaceutical agency, which oversaw the development of weapons using germs and viral agents. The program continued to function (albeit at a reduced capacity) after the Soviet Union collapsed, contrary to initial assurances that it would be closed. Russian research on biological weapons has been conducted at massive facilities both close to and far from large urban centers. Among the institutes responsible for the development of weapons based on natural and genetically engineered strains of bacteria and viruses are the State Research Center of Virology and Biotechnology (VEKTOR) in Koltsovo, the State Research Center for Applied Microbiology at Obolensk, the State Research Center for Toxicology and Hygienic Regulation of Biopreparations in Serpukhov, and the Institute of Molecular Biology in Moscow.

At their height, the Soviet chemical and biological weapons (CBW) programs collectively employed over 70,000 scientists and technicians. In the early 1990s, after the Russian government made limited cuts in the program, the CBW complex continued to employ over 60,000 people, though only about one-third of these possessed truly sensitive knowledge. By the mid- to-late 1990s, after more of the Soviet WMD infrastructure had been dismantled, up to 10,000 CBW scientists still posed a proliferation threat according to a detailed study by Glenn Schweitzer of the

National Academy of Sciences. Schweitzer's estimate is compatible with figures provided in an April 2000 report by the U.S. General Accounting Office (GAO), which notes that 5,000 senior CBW scientists in Russia could pose "significant proliferation risks," and that an additional 10,000 Russian workers possess skills relevant for weapons development and production. Similar data can be found in a recent report by Amy Smithson of the Henry L. Stimson Center, who argues that 7,000 biological weapons scientists and another 3,500 chemical weapons experts in Russia pose a "high-risk proliferation concern."

These figures for the Russian CBW industries, combined with the estimates for Russia's nuclear weapons complex, give an idea of the potential for strategic proliferation. The figures bear out estimates made in 1998 that at least 15,000 senior scientists and engineers in Russia are directly involved in "production, delivery systems, and other aspects of weapons of mass destruction," beyond the 2,000-3,000 nuclear weapons design specialists who pose the greatest threat of nuclear proliferation. Moreover, as Schweitzer's study shows, if other tasks of clear "proliferation concern" are taken into account, the total number of Russian scientists and engineers with valuable WMD expertise is three to four times larger than the core 15,000-18,000. Schweitzer maintains that a total of around 60,000 former Soviet aerospace, nuclear, and chemical/biological weapons specialists "developed and designed weapons of mass destruction and their delivery systems"—thereby posing the greatest threat of proliferation—from 1992 to 1996. This figure, he argues, is largely unchanged today.

Identical estimates can be found in two recent GAO reports and in the latest annual report from the Initiatives for Proliferation Prevention (IPP), a program sponsored by the U.S. Department of Energy that seeks to provide employment for former Soviet WMD experts. The first of the two GAO reports notes that roughly 60,000 of the one million scientists, engineers, and technicians at Russia's 4,000 scientific research institutes can be regarded as

high-level WMD personnel, a figure that is also cited (with breakdowns by WMD category) in the IPP document. The other GAO report, released in May 2001, cites a range of estimates by U.S. officials in Russia who believe that Soviet WMD programs as of 1991 were crucially dependent on as many as 75,000 highly-trained scientists and engineers, most of whom continue to serve in those posts.

Thus, although the risk of WMD proliferation in the former Soviet Union depends on the definitions used, it is safe to conclude that the greatest danger is posed by some 60,000 to 75,000 specially trained scientists, engineers, and technicians, nearly all of whom now reside and work in Russia. Even if the upper end of this range is used, Western countries could potentially absorb 75,000 experts and their families without extreme difficulty. The emigration of these personnel from Russia will be limited not by the West's absorptive capacity, but by obstacles within Russia itself.

RUSSIA'S SCIENTIFIC BRAIN DRAIN

The civilian side of Russian science and technology was hit hard by the economic and political turmoil that engulfed the former Soviet Union from the late 1980s through the mid-1990s. Spending on science programs dropped by nearly 45 percent in real terms during the final 2 years of the Soviet regime, and it continued sharply downward in 1992. Soaring inflation, large budget deficits, and persistent shortages of funding at scientific research institutes led to sharp declines in researchers' salaries (after adjusting for inflation), delays in wage payments, poor upkeep of facilities, and increasing obsolescence of laboratory equipment.

The severity of financial constraints and the deterioration of research facilities prompted a growing number of scientists in Russia to pursue opportunities outside their institutes, either at home (particularly in the newly emerging private sector) or abroad (at universities, research centers, and private companies). This

development was not entirely unprecedented. Although Soviet citizens normally were forbidden to travel abroad (except to the Communist countries of Eastern Europe), the USSR experienced a scientific brain drain in the 1970s when a significant number of Jewish and Armenian scientists were allowed to emigrate. This earlier brain drain, however, was greatly eclipsed by the exodus that began at the end of the Soviet era, when most of the restrictions on foreign travel were lifted. Russia's brain drain in the 1990s was both external (with the departure of scientists to overseas jobs) and internal (as scientists abandoned their research and shifted into other sectors of the economy). The depletion of scientific talent was especially acute during the first 2 years after the collapse of the Soviet Union.

Data on the post-Soviet brain drain are often unreliable, but the scale and basic patterns of the phenomenon can be gauged reasonably accurately from a number of recent reports and surveys. All of these studies suggest that the scientists who moved abroad during the last few years of the Soviet regime included a disproportionate number of Jews, ethnic Germans, and Armenians. Many of the scientists were prominent researchers, and some were leaders in their fields. Nearly three-quarters of those who left during this initial wave continued their scientific research abroad at either universities or research institutes. The large majority (at least 80 percent) of the departing scientists went to either Israel or Germany, though a significant number subsequently moved to the United States. The initial wave of migration accelerated in 1990, when nearly 800 scientists and 8,000 engineers from the Soviet Union (many of whom had moved abroad in earlier years) came to the United States. Another 2,200 scientists left the Soviet Union in 1991. It is important to note, however, that only a relatively small proportion of these scientists—no more than 15 to 20 percent—applied for permanent residence abroad. Most of those who left Russia at this point were intending to return.

The exodus of Russian scientists increased after the Soviet Union collapsed at the end of 1991. In May 1992, as public concern about the external brain drain mounted, Russian president Boris Yeltsin issued a decree authorizing “emergency measures to preserve the scientific and technological potential of the Russian Federation.” This decree proved largely ineffective, however. The measures proposed by Yeltsin, including tax breaks for key research institutes and competitive funding for scientific research grants, were hardly enough to offset the impact of the country’s deepening economic problems. In both 1992 and 1993, roughly 3,000 Russian scientists went abroad for extended periods, particularly to Germany, Israel, and the United States. Physicists and mathematicians made up the bulk of the outflow, and biologists and chemists accounted for most of the rest. Fewer than half of the scientists who moved to foreign countries during these years continued to pursue scientific research, opting instead for more lucrative alternatives. Although only a small proportion (around 8 to 10 percent) of the scientists who went abroad in the early 1990s intended to stay away permanently, the overseas exodus from the civilian scientific institutes exacted a significant toll. The problem was not so much the magnitude of the external brain drain as the quality of those who left. The emigrants included some of the most gifted scientists, particularly those of the younger generation:

In purely quantitative terms, the scientists who moved permanently abroad did not constitute a significant outflow. But those who left included a disproportionate number of talented, experienced, and highly trained young scientific workers. . . . The emigration of scientists and talented young researchers weakened the scientific potential of Russia and threatened to result in the country’s loss of entire scientific fields and schools, which were forced to “survive” with only a narrow group of highly qualified scientific elites.

Even more worrisome from the Russian government’s perspective was the internal brain drain. Thousands of scientists moved into other sectors of the economy,

especially private business. A recent study suggests that the internal brain drain in 1992-1993 was at least five (and perhaps ten) times greater than the external drain, especially among younger scientists. A senior official in the Russian Academy of Sciences, Aleksandr Andreev, claimed in 1992 that 40 percent of Russia's research physicists had left the Academy's institutes and research centers. Although other sources indicate that Andreev's figures are too high, there is little doubt that a significant proportion of the Russian physics community was depleted by the internal and external brain drain.

Ominous though these trends were, they did gradually abate. Some of the most talented Russian scientists, who had received numerous offers from abroad, expressed their determination to stay in Russia to uphold and strengthen the country's scientific traditions. A typical case was Academician Aleksei Khokhlov, a distinguished physicist specializing in nonlinear optics, who committed himself to preserving the physics community in Russia:

On numerous occasions, [foreign universities] have proposed that I move to the West. Although I value these offers, I realize that I would not be able to live there. I want to develop science here in Russia and to make a contribution to my own country. This is where my roots are, and I cannot imagine myself living outside Russia.

By the late 1990s, the external brain drain had sharply diminished. Specialists in microbiology, genetics, and computer science were still leaving the country, but far fewer mathematicians, physicists, and chemists were departing.

Recent data suggest that the annual number of Russian scientists and engineers from civilian institutes who went abroad for extended periods dropped from around 3,000 in the early 1990s to roughly 1,000 in later years, a trend that has been welcomed by the Russian government. In a statement to the Russian Duma in November 1999, the Russian minister of science and technology, Mikhail

Kirpichnikov, hailed the decrease in annual emigration. He stressed that only 1.6 percent of the scientists who had quit or been dismissed from their jobs in Russia were abroad at that time. Although the rate of departures to foreign countries rose in 1999 to 1,400 compared to an average of 1,000 in 1994-1998, this was a one-time increase sparked mainly by the financial crisis of August 1998. (Moreover, even though the number of scientists who moved abroad in 1999 was greater than in 1998, the exodus was well below the levels of emigration in the early 1990s.)

The internal brain drain also slowed markedly by the late 1990s. Most of the scientists who decided to leave their institutes for other pursuits did so in the early 1990s, and the ones who stayed were much less inclined to look for work outside the Academy. The gradual settlement of wage arrears for Academy employees in 1999-2001, and the increased funding for science programs from 1999 on, further reduced the likelihood that Russian scientists would consider giving up their institute positions. The number of scientific researchers in Russia rose in 1999 for the first time since the mid-1980s, and the trend continued upward in 2000 and 2001. Moreover, the number of graduate students enrolling in physics, mathematics, astronomy, chemistry, geology, and biology at Russian universities rose steadily in the 1990s, offering hope that an abundance of younger scientists would be available to fill posts at research institutes and universities in coming decades.

Reverberations within the WMD Complexes.

The upheavals of the late 1980s and 1990s took their greatest toll on Russia's civilian scientific institutes and non-nuclear defense plants, but the WMD complexes were not wholly immune either. During the Communist era, the living standards of nuclear weapons scientists were much higher than those of the average Soviet citizen. The privileged status of the closed cities continued for a while after the demise of the Soviet Union, but it gradually

eroded. By mid-1994, the combined impact of ravaging inflation and budgetary constraints was being felt throughout the nuclear arms complex. In an interview in September 1994, the director of the Avangard weapons assembly facility in Sarov, Yurii Zavalishin, condemned the Russian ministry of defense and ministry of finance for “failing to turn over a huge amount of money they owe us.” He said that his plant was “perhaps the only enterprise in the [nuclear weapons] sector that is still able to pay wages on a regular basis.” The highly publicized suicide of the director of the VNIITF design center in Snezhinsk, Vladimir Nechai, in October 1996 provided only the most vivid confirmation of the hardships that arose at many weapons facilities. In at least two cases, employees of the nuclear weapons complex went on strike to demand the payment of back wages. Scientists at CBW plants encountered similar problems.

It is not surprising, then, that some of the WMD specialists began to look for work outside their institutes or even to think about moving overseas. Although very few residents of the closed cities had any foreign contacts or knew how to pursue opportunities abroad, surveys conducted in mid-1992 revealed that 46 percent of the scientists, engineers, and managers at nuclear weapons facilities were interested in seeking positions outside Russia. Among aerospace and missile experts, the level of interest in working overseas was even greater, roughly 62 percent. Comparable surveys are not available for BW or CW specialists, but it is safe to assume that they were at least as interested as the nuclear weapons scientists in going abroad. Although only a small number of the nuclear weapons specialists (an average of 1 percent a year in the 1990s) actually ended up taking jobs abroad, the outflow of these personnel in the first half of the 1990s provoked anxiety in both Russia and the West.

Whether this anxiety was fully warranted is unclear. On one hand, the surveys in 1992 revealed that the best and most experienced nuclear weapons specialists were *not*

interested in working abroad. Although the situation was quite different in the aerospace and missile sector where some of the most capable experts were interested in going overseas, the lack of interest among leading nuclear weapons scientists was conducive to nonproliferation efforts. On the other hand, if even a few of the key Russian weapons scientists had moved to high-risk countries like North Korea, Iraq, and Iran, the impact on nonproliferation goals would have been grave. Scattered reports in the Russian press and some Western newspapers about the supposed presence of former Soviet WMD scientists and engineers in a variety of Third World states—Algeria, Brazil, Iran, Iraq, Libya, North Korea, Paraguay, South Korea, Syria, and Venezuela—have never been verified by any credible evidence. Although a report published by *The Russia Journal* in April 1999 claimed that around 2,000 Russian weapons specialists were working in China, these presumably were not WMD scientists but simply advisers and technicians who were temporarily based in China to facilitate Russia's ongoing transfers of advanced conventional armaments and military production technology.

Even though reports about Russian weapons scientists in Third World countries must be treated with great caution and skepticism, one cannot entirely dismiss the possibility that some departures to rogue states or the enlistment of scientists by international terrorist organizations will eventually occur. As discussed below, if projected improvements in the working conditions for most scientists in Russia are not sustained, the pool of scientific researchers and technicians who are willing to emigrate from the closed cities and other regions may grow. A Russian expert on the brain drain estimated in 1997 that as many as 8,000 scientists with experience in nuclear technology and fissile materials were prepared to leave to work abroad. This figure may not include any high-level weapons scientists, but it is conceivable that at least a few of these individuals possess expertise that would be helpful to

a fledgling nuclear weapons program. Some countries of great concern to the West have reportedly tendered offers to Russian chemists and biologists as well as to nuclear physicists. A front-page article in *The New York Times* in December 1998 claimed that Iranian officials were attempting to enlist Russian scientists for germ warfare projects by offering salaries of up to \$5,000 a month. Despite persistent reports of such offers and despite the well-known Russian-Iranian cooperation on the Bushehr nuclear power plant, no hard evidence has yet emerged that any Russian scientists have defected to Iran specifically to work on WMD programs. Even so, the reported magnitude of these offers is disconcerting in light of the fact that some scientists were earning monthly salaries less than one-hundredth that amount as late as 1996.

Nevertheless, the impact of the funding problems must be kept in perspective. Since the late 1990s, many of the problems have been rectified. The pay for nuclear weapons scientists and engineers was sharply increased in both 1999 and 2000, as discussed below. Moreover, even when funding shortfalls were especially severe in the mid-1990s, the rate of emigration actually began falling, not increasing. The importance of this trend was underscored by a survey of hundreds of Russian nuclear weapons specialists and ballistic missile scientists in 1999, which revealed that their desire to emigrate had decreased sharply since the early 1990s. The results of the survey are presented in a study published in 2001 by the Carnegie Endowment for International Peace. The study indicates that the rate of emigration from the ten closed cities increased from 1991 to 1996 and then began steadily dropping. Although an average of about 1 percent of the total pool of surveyed experts went to work abroad each year in the 1990s, the large majority of the departures occurred in the first half of the decade. In 1992, 46 percent of those interviewed at nuclear weapons facilities expressed a desire to work abroad, whereas only 9 percent expressed the same interest in 1999—a fivefold decline. The surveys revealed the same

pattern at the ballistic missile facilities. Whereas 72 percent of respondents at ballistic missile plants in 1992 said they wanted to work abroad, only 25 percent expressed that view in 1999.

The survey also showed that even among the weapons experts who were still hoping to work abroad, very few were actively taking steps toward that end. Only one-third of the relatively small number of nuclear weapons specialists who were willing to work abroad said they were actively looking for foreign employment. Among missile experts who wanted to work abroad, only one-fifth were searching for employment. It is interesting to note, however, that some 21 percent of nuclear specialists and 42 percent of missile specialists approved of or envied those who left Russia, whereas only 16 percent of nuclear specialists and an equal percentage of missile specialists held negative views of emigrants. (About 60 percent of nuclear specialists and 42 percent of missile specialists claimed that their views were neutral.) These statistics suggest that a considerable minority of the researchers who have chosen to stay in Russia's closed cities might eventually think about seeking work abroad. This would be likely especially if economic conditions in the closed cities (and in Russia as a whole) were once again to deteriorate. One of the key findings of the survey is that 85 percent of respondents who wanted to work abroad cited economic motivations. Only 15 percent of the prospective emigrants indicated that they had purely professional reasons for leaving.

One other key finding of the survey is that the actual pattern of emigration by nuclear and missile specialists in the 1990s was very similar to that of the larger scientific community (as described above). Most of the weapons specialists who applied for permanent residence when they moved abroad went to Israel, Germany, or the United States. For those who were still in Russia but were hoping to work abroad, the most popular intended destination was Western Europe (listed in 45 percent of definitive replies), followed by North America (28 percent) and the Middle East

(10 percent), principally Israel. Missile specialists who wanted to go abroad were most interested in seeking work in Western Europe (79 percent), North America (63 percent), and Israel (9 percent). The countries most frequently rejected by nuclear weapons specialists as potential destinations were Iraq (59 percent), Pakistan (42 percent), Libya (33 percent), Iran (24 percent), North Korea (16 percent), Israel (16 percent), India (13 percent), and China (11 percent). Missile specialists who wanted to work abroad were much less inclined to rule out any countries as potential destinations, but 18 percent did not want to work in Israel, 17 percent rejected China, 16 percent rejected Pakistan, and 11 percent ruled out Iran.

These data suggest that, if there were a resurgence of interest in emigration among Russian weapons scientists, Western countries would have little to fear from it. Even the very small number of Russian experts who might be willing to work for hostile Third World regimes could undoubtedly be induced to move to the West instead.

LIMITED EFFORTS TO ADMIT RUSSIAN SCIENTISTS INTO THE UNITED STATES

The U.S. Government's primary emphasis has been on keeping former Soviet WMD scientists gainfully employed in their own countries, rather than encouraging them to move permanently to the West. The United States did, however, take in a substantial number of civilian scientists and technicians from Russia in the 1990s, perhaps as many as 7,000, most of whom emigrated shortly after the demise of the Eastern bloc. Other countries also received sizable numbers of Russian scientific experts. The three that absorbed the most in the early 1990s were Israel, Germany, and Greece. According to Schweitzer, roughly 2,000 of the 5,000 "scientific emigrants" from Russia to the West in 1991-1994 were "active researchers." It is unclear, however, how many of these emigrants were involved in WMD research or other defense-related projects.

FISCAL YEAR	Russia*				Ukraine*			
	Total	Priority Workers**	Workers with Advanced Degrees or Exceptional Ability***	Professional Specialty / Technical	Total	Priority Workers**	Workers with Advanced Degrees or Exceptional Ability***	Professional Specialty / Technical
1991†	55,960	na§	na§	4,491				
1992	8,837	135 (SU)	385 (SU)	881	14,383	na	na	785
1993	12,079	750 (SU)	303 (SU)	1,163	18,516	na	na	1,385
1994	15,348	1,384 (SU)	516 (SU)	1,399	21,033	na	na	907
1995	14,560	1,336 (SU)	402 (SU)	2,603	19,432	na	na	3,499
1996	19,648	1,798 (SU)	810 (SU)	2,830	23,879	na	na	3,628
1997	16,432	862	338	2,772	18,898	110	78	1,293
1998	11,529	788	383	2,587	7,448	129	69	849
1999	12,147	467	273	889	10,123	128	66	1,014
2000	-	-	-	-	-	-	-	-

Source: U.S. Immigration and Naturalization Service, *Statistical Yearbook*, Washington, DC, annual editions, 1991 to 1999. Official data for FY2000 have not yet been tabulated.

na = not applicable.

* Figures are tabulated by country of birth.

** Of the five categories of employment-based preferences for immigration to the United States, two are relevant to the topic of this chapter. “Priority workers” fall into the first employment-based category, known as EB-1 (first preference). EB-1 visas are for “persons of extraordinary ability in the sciences, arts, education, business, or athletics, outstanding professors and researchers, and certain multinational executives and managers.” **NB:** The figures reported here for FY 1992 through FY 1996 are for the whole of the former Soviet Union (SU), not just for Russia. Unfortunately, the INS did not start reporting separate data for EB-1 emigrants from Russia and Ukraine until FY 1997.

*** This rubric designates the second of the five categories of employment-based preferences for immigration, a category known as EB-2 (second preference). EB-2 visas are for “professionals holding advanced degrees and persons of exceptional ability in the sciences, arts, and business.” The INS must determine that the “exceptional ability” of an EB-2 immigrant will “substantially benefit the national economy, cultural, or educational interests or welfare of the United States.” **NB:** The figures reported here for FY 1992 through FY 1996 are for the whole of the former SU, not just for Russia. Unfortunately, the INS did not start reporting separate data for EB-2 immigrants from Russia and Ukraine until FY 1997.

§ Figures for FY 1991 were reported only for the SU as a whole.

§§ In FY 1991 there was only one employment-based preference for immigrant admissions, a preference granted to “professionals and highly skilled workers.” A total of 32 individuals from the SU were admitted within this category in FY 1991. The five-tiered system of

Table 1. Immigrant Admissions to the United States from Russia and the Ukraine, 1991-99.

	Former Soviet Union*									
FISCAL YEAR	Total Nonimmigrant Admissions	Admissions for Temporary Work, Exchanges, or Intra-company Transfers	O-1 Admissions** (for Aliens with Extraordinary Ability in Sciences and Other Fields)	H-1B Admissions*** (for Aliens with Specialty Occupations)	J-1 Admissions ¹ (for Exchanges Involving Professors, Research Scholars, and Others)					
1991 ¹⁸	111,648	7,804	na	3,827	3,791					
1992	107,750	7,497	28	2,452	2,960					
1993	127,840	12,223	105	1,390	7,949					
	Russia			Ukraine						
	Total Admissions	Temporary Work, Exchanges, Transfers	O-1**	H-1B***	J-1 ¹	Total Admissions	Temporary Work, Exchanges, Transfers	O-1**	H-1B***	J-1 ¹
1994	107,593	14,882	190	1,074	9,545	18,728	2,381	18	166	662
1995	131,665	18,998	416	2,048	11,263	22,716	2,722	34	378	674
1996	145,536	16,860	225	2,190	13,682	26,610	3,640	29	368	862
1997 ¹⁹	-	-	-	-	-	-	-	-	-	-
1998	164,548	16,546	320	3,014	9,251	28,674	3,845	25	529	1,156
1999	192,761	18,221	368	3,262	16,289	34,288	3,821	34	720	2,336
2000	-	-	411	3,769	-	-	-	59	796	-

Source: Data for FY1991 to FY1999 are from U.S. Immigration and Naturalization Service, *Statistical Yearbook*, Washington, DC, annual editions, 1991 to 1999. Data for FY 2000 were provided by INS and U.S. Justice Department officials.

na = not applicable.

* Only aggregate figures for all former Soviet nonimmigrants are available for the period FY 1991-93. The subsequent figures for Russia and Ukraine are tabulated by country of citizenship.

** O-1 visas are for temporary visits by aliens who have displayed “extraordinary ability in the sciences, education, business, or athletics.” Several criteria must be met before an O-1 visa is granted. The INS requires, among other things, “a written advisory opinion from a peer group [or] a person designated by the group with expertise in the alien’s area of ability,” “a copy of any written contract between the employer and the alien,” “evidence that the alien has received a major, internationally-recognized award, such as a Nobel Prize,” and evidence of other extraordinary ability, possibly including membership in a professional organization based on outstanding achievement, “published material in professional or major trade publications, newspapers, or other major media about the alien and his work in the field,” “original scientific, scholarly, or business-related contributions of major significance in the field,” “authorship of scholarly articles in professional journals or other major media in the field,” and a record of compensation and employment responsibilities commensurate with those of extremely gifted and accomplished individuals.

*** H-1B visas are given to “aliens coming temporarily to perform services in a specialty occupation, or as a fashion model of distinguished merit and ability.” H-1B visas are divided into three categories: H-1B1, H-1B2, and H-1B3. The large majority of H-1B visas for individuals from Russia and Ukraine are H-1B1 visas, which apply to “an alien coming temporarily to perform services in a specialty occupation.” A

“specialty occupation” is defined as one involving “the theoretical and practical application of highly specialized knowledge requiring completion of a specific course of higher education.” Only a relatively small number of Russians and Ukrainians qualify for H-1B2 visas (for aliens “coming temporarily to perform services of an exceptional nature relating to a cooperative research and development project administered by the Department of Defense”) and H-1B3 visas (for fashion models of distinguished merit). H-1B holders are permitted to work in the United States for an initial period of 3 years, which, at the employer’s request, can be renewed for a further three years.

§ J-1 visas are used for “educational and cultural exchange programs” in “the fields of education, arts, and sciences. Participants include students at all academic levels; trainees obtaining on-the-job training with firms, institutions, and agencies; teachers of primary, secondary, and specialized schools; professors coming to teach or do research at institutions of higher learning; research scholars; professional trainees in the allied and medical fields; and international visitors coming for training, sharing, or demonstrating specialized knowledge or skills.”

§§ No figure for O-1 visas is given here for FY1991 because the category did not begin until FY1992. The figure given here for H-1B visas in FY1991 actually refers to H-1 visas. Figures for H1-B visas begin with FY1992.

§§§ The INS *Statistical Yearbook* for 1997 reports that “no reliable data are available for 1997” for nonimmigrant admissions (p. 111). The INS website (<http://www.ins.gov>) erroneously presents FY 1996 data as the figures for FY1997.

Table 2. Nonimmigrant Admissions to the United States from Russia and Ukraine, 1991-2000.

The U.S. Immigration and Naturalization Service (INS) does not regularly provide disaggregated statistics on the number of foreign scientists and engineers who move to the United States, but several of the categories used by the INS for immigrant and nonimmigrant admissions give an indication of trends in the entry of scientists from Russia and Ukraine. Tables 1 and 2 contain annual data for immigrant and nonimmigrant admissions, respectively, from both Russia and Ukraine. The trends for the two countries are essentially identical. The number of immigrants in relevant categories rose sharply each year from 1991 to 1995, but declined just as precipitously from 1996 through 1999 (the most recent year for which data are available). Assuming that scientists made up a relatively

stable percentage of the numbers in each category, the trend depicted here tallies very well with the data presented above on the brain drain from the former Soviet Union. When the brain drain was increasing, the number of scientists admitted as immigrants into the United States also increased; and when the exodus of scientists from Russia and Ukraine diminished, the volume of immigrant admissions declined.

Even when the brain drain from Russia and Ukraine was at its height, the number of former Soviet scientists who moved permanently to the United States was not especially large. Data compiled unofficially by the U.S. National Science Foundation (NSF) indicate that 426 Russian scientists and engineers received immigrant visas to the United States in FY1993, and another 512 received such visas in FY1994, an increase of roughly 25 percent. The number of Russian scientists and engineers who immigrated to the United States rose again in FY1995 but then declined sharply in FY1996, FY1997, and FY1998 (the latest year for which data are available). The difference between the early 1990s and the late 1990s was striking. Whereas more than 450 scientists and engineers a year were emigrating from Russia to the United States in FY1994 and FY1995, the number emigrating from the whole of the former Soviet Union fell to under 200 annually by the late 1990s.

The INS data for nonimmigrant admissions, shown in Table 2, reveal a pattern quite different from that of immigrant admissions. The number of Russian and Ukrainian citizens entering the United States in the late 1990s for temporary work and exchanges, including science-related programs, remained considerably higher than it was earlier in the decade. In the two most relevant categories—O-1 and H-1B admissions—the trend after 1993 was steadily upward, with the one exception of O-1 visas in 1996. In a third, somewhat more diffuse visa category—for J-1 admissions—the trend was sharply upward in the early-to-mid 1990s and relatively stable

thereafter. (Definitions of O-1, H-1B, and J-1 visas are provided in the explanatory notes for Table 2.) The figures for H-1B (temporary work) visas are especially useful in highlighting the pattern of scientific entrants from the former Soviet Union. Statistics compiled by the INS show that roughly three-quarters of H-1Bs in 1998-2000 went to scientists and engineers, predominantly those under 35 years of age. Computer experts, in particular, accounted for 55-60 percent of all H-1B recipients during this period. Although Russia ranked far behind India and China—the world's two most populous countries—in the number of its citizens who received H-1Bs, the surge of Russian visa holders after 1993 elevated Russia to tenth place overall, well ahead of countries like Brazil and Indonesia, whose populations are of comparable size.

In short, the trends depicted in Tables 1 and 2 confirm that even though only a relatively small and dwindling number of scientists and engineers from the former Soviet Union immigrated to the United States in the 1990s, a substantial and growing number were admitted for temporary research positions and scientific exchanges.

The U.S. emphasis on temporary rather than immigrant admissions for former Soviet scientists has been driven partly by the demand side, that is, the number of Russians and Ukrainians applying for visas each year. As the number seeking to immigrate to the United States has fallen, it is not surprising that the quantity of immigrant visas awarded has dropped. By the same token, as the number of H-1B petitions for Russians and Ukrainians has risen, the number (though not necessarily the proportion) of visas approved has grown.

The U.S. emphasis on temporary admissions for Russian scientists has been reinforced by changes in U.S. immigration law in 1990, 1998, and 2000, which set stricter limits and fewer exemptions for employment-based immigrant admissions and which expanded the number of H-1B nonimmigrant admissions. Under changes adopted in

October 2000, scientists who are admitted on H-1B visas to work for universities or nonprofit research centers are exempted altogether from the newly increased ceilings for H-1Bs.

The emphasis on temporary rather than permanent admissions has also been partly due to the limited capacity of prospective employers to absorb foreign specialists. By the mid-1990s, many U.S. companies had reached a saturation point, especially for mathematicians, physicists, and chemists, some of whom had not been as rigorously trained as their American counterparts. Only in a few select fields, such as computer programming and biotechnology, did the demand for foreign specialists persist, and even then it was only for those who had been properly trained.

One final factor that shaped U.S. admissions policy vis-à-vis Russian scientists (especially weapons scientists) was the sensitivity of the issue for the Russian authorities. The potential for bilateral friction on this matter was evident as early as October 1992, when the U.S. Congress approved the Soviet Scientists Immigration Act (SSIA), a bill that enabled up to 750 former Soviet WMD scientists, as well as their spouses and dependents, to qualify for permanent residence in the United States under an employment-based preference (EB-2), even if they had not received an actual offer of employment. The SSIA triggered a harsh response in Russia, where legislators and political officials depicted it as an ominous “attempt by the United States to open the floodgates for Russian defense scientists.” Russian officials complained both publicly and privately about the U.S. law and called for it to be rescinded. Commentators in the Russian press voiced deep suspicion and nationalist recriminations against “hostile foreign powers . . . seeking to deprive our homeland of its secrets.” They claimed that the United States was “exploiting our country’s immense scientific resources for its own mischievous ends.” The resulting backlash was precisely the type of thing that U.S. officials had hoped to avoid.

The irony of the Russian complaints is that they were based on a misreading (or willful distortion) of the U.S. legislation. The SSIA was never intended to be more than a one-time measure. It was certainly not the start of a systematic effort to induce many thousands of former Soviet WMD scientists to resettle permanently in the United States. No one in Congress or the executive branch ever contemplated offering immigration visas to tens of thousands of Russian weapons experts. On the contrary, some members of Congress—particularly those from districts in which the U.S. nuclear weapons laboratories were located—had argued in early 1992 (when the SSIA was first proposed) that the entry of even a small number of former Soviet weapons scientists to work in the United States would be undesirable:

At a time when America's nuclear scientists are being laid off by defense cuts because of the declining Soviet threat, the United States Department of Energy is luring Soviet scientists to work on nuclear fusion and space missile defense. . . . We are now displacing our best and brightest American scientists. What do the hundreds of American scientists at Los Alamos, Sandia, Oak Ridge, and our other national laboratories facing possible layoffs think of this practice? They have been toiling against the Soviet bear for years. Because of these scientists we won the cold war. What is their reward? They may be fired and replaced by Russian scientists.

In part because of these complaints, congressional sponsors of the SSIA repeatedly emphasized its limited nature. When the House of Representatives took up the legislation in the fall of 1992, the chief sponsor, Romano Mazzoli, underscored the modest scope of the bill:

[The SSIA] waives a legal requirement, which is in the 1990 [immigration] law now, but waives it for only a 4-year period, not permanently, and only for a total of 750 scientists. . . . [The bill] raises no quotas nor ceilings on foreign workers. It only opens the door slightly and somewhat facilitates for a limited period of time and for a limited number of former Soviet scientists their entry into the United States.

Supporters of the SSIA also stressed that it was “narrowly targeted to address a specific and highly unique situation” and would be implemented “without cost to the American taxpayer and without displacing anyone who has been waiting to immigrate to the United States.” The committee hearings and brief floor discussion left no doubt that the legislation was designed to cover only a very small percentage of Russian WMD scientists.

In practice, moreover, the SSIA turned out to be even more limited than the sponsors had envisaged. The original text of the bill had to be supplemented by interim rules prepared by the INS in 1993 and 1995. After a lengthy review process, the INS adopted a final rule in February 1997 that incorporated the 1995 changes. These modifications, based on comments solicited by the INS, clarified which categories of scientists and technicians from the former Soviet Union were eligible to apply for immigration visas under the SSIA. The initial draft rule had defined eligible applicants as “scientist[s] or engineers . . . who have expertise in chemical, biological, or other high technology fields,” a broad description not limited to weapons personnel. But the amended 1995 interim rule had explicitly mentioned expertise in “a high-technology field which is clearly applicable to the design, development, or production of ballistic missiles, nuclear, biological, chemical, or other high-technology weapons of mass destruction” as a qualifying criterion. The INS subsequently narrowed the scope of the rule to exclude scientists and engineers who were not directly engaged in strategic weapons projects. This revision left out all nondefense scientists and technicians whose work was potentially applicable to WMD programs. The INS preserved these changes and others in the final 1997 rule, but the impact of the guidelines was largely negated by the agency’s failure to extend the cutoff date for petition approvals beyond the original deadline of October 24, 1996. Thus, contrary to the complaints voiced by Russian officials,

the SSIA proved to have only a minuscule effect at best on the Russian WMD complexes.

Even though Russian commentators had misconstrued (or deliberately misrepresented) the SSIA, their adverse response to the legislation was bound to cast a pall over any further such efforts. Subsequent programs undertaken by the U.S. Department of Energy (DOE) and other U.S. Government agencies were aimed mainly at providing employment for former Soviet weapons scientists and engineers within their native countries, rather than encouraging them to immigrate to the West. Although roughly 60 Russian “technical specialists for nuclear reactors” were “semi-permanently” relocated to New Mexico in 1995 for work on the Topaz Project (a project to adapt compact nuclear power plants for space vehicle propulsion), the transfers were limited in number and did not spawn a mass exodus of scientific and engineering talent from Russia or the other former Soviet republics.

U.S. EFFORTS TO EMPLOY WEAPONS SCIENTISTS IN RUSSIA

To minimize the likelihood that Russian WMD scientists and engineers would be enticed by lucrative offers from a hostile Third World country, the United States has launched several initiatives to provide worthwhile employment for highly-trained experts who stay in Russia. This approach has been seen as a substitute for, not a supplement to, the possible immigration of these scientists to the West. After private U.S. organizations (the Carnegie Corporation and the MacArthur Foundation) began awarding research grants to former Soviet scientists in 1992-93, the U.S. Departments of Defense and Energy embarked on a number of projects of their own. By 1995, Russia had become the single largest beneficiary of U.S. funding for programs encompassed by the International Cooperation in Research and Development (ICRD) effort, with particular emphasis on aeronautics and nuclear

energy. The ICRD grants were separate from the money appropriated for the Nunn-Lugar Cooperative Threat Reduction (CTR) program and for a number of DOE and State Department projects designed specifically to reduce the strategic proliferation threat posed by Russian weapons experts.

Many of the activities funded by the CTR and DOE, such as the dismantling of strategic missiles and the installation of protective devices and surveillance equipment at key storage facilities in the former Soviet republics, have been exceptionally valuable in helping to safeguard nuclear weapons and components. The focus here is not on CTR as a whole or on all DOE activities, but on the three specific DOE and State Department programs that were set up in the 1990s for the express purpose of keeping former Soviet WMD scientists gainfully employed: (1) the Science Centers program, (2) the Initiatives for Proliferation Prevention, and (3) the Nuclear Cities Initiative (NCI). These programs were championed by the Clinton administration, but their fate seemed to be in doubt when a new administration came in under George W. Bush. Whatever uncertainty may have existed, however, was dispelled in mid-December 2001 when President Bush declared that, far from eliminating the programs, he would “**expand** efforts to provide peaceful employment for scientists who formerly worked in Soviet weapons facilities.” Although the administration subsequently announced that it would merge the NCI with the IPP, senior officials confirmed that the basic activities of the two programs would be continuing and that funding for the Science Centers would be increased.

The question addressed in the Appendix to this chapter is whether these sorts of programs, taken together, can provide permanent alternative sources of employment for all or most of the Russian WMD experts within the next 10 to 15 years. Even if the answer is negative, the programs may still be worth pursuing for other reasons (e.g., for intelligence-gathering or to foster professional camaraderie). For the purposes of this chapter, however,

the only relevant concern is whether the programs can generate long-term alternative employment for Russian WMD specialists. The answer provided in the Appendix is unambiguously negative.

THE RUSSIAN PRIVATE SECTOR

Defense conversion and the transfer of displaced scientific and technical personnel to new jobs pose formidable challenges even for countries with highly advanced market economies like the United States. Although Silicon Valley and other private-sector opportunities have absorbed large numbers of scientists and technicians from U.S. Government weapons laboratories, the process of downsizing the U.S. nuclear weapons complex inevitably has been disruptive for many.

In Russia, the difficulty of finding opportunities for displaced weapons scientists is incomparably greater. Yurii Zavalishin, the director of the Avangard weapons assembly plant, expressed dismay in 1994 that soon after his staff “became actively involved in the state conversion program and began working on a broad scale, the whole program turned sour.” Although some of the former employees of the Russian nuclear and missile complexes (mostly younger people) successfully landed jobs in the fledgling private sector or with foreign companies, the total number who managed to do so was trivial compared to the number who may be displaced over the next several years if much-needed downsizing of the Russian WMD complexes proceeds as forecast.

The lack of progress with defense conversion in Russia, the poor business climate, and the many obstacles facing aspiring entrepreneurs have stifled the emergence of a private sector that could absorb thousands of WMD scientists. Although one-third of Russian defense enterprises had been “privatized” (i.e., turned over to managers) by the mid-1990s, the rest were still owned wholly or largely by the state. Even the nominally private

defense firms were kept open mainly through state largesse. Unlike in Hungary, Poland, Slovenia, the Czech Republic, and other East-Central European countries where the rapid growth of small business made up for the shortcomings of large industry, no such engine of prosperity has been available in Russia. Overweening government interference, corruption, and criminality in Russia have thwarted indigenous start-ups and deterred foreign investors from entering. As a result, nothing remotely comparable to the private-sector opportunities in the United States is likely to exist in Russia for many years to come.

The scarcity of opportunities outside the weapons complexes poses an onerous dilemma for Russian scientists who face the prospect of unemployment. Most evidence suggests that a greater number of the WMD personnel, especially those under 45, would have been inclined to take jobs in the private sector if the opportunities had been available. According to recent data, some 70,000 scientists working at Russian Academy of Sciences institutes—on projects unrelated to WMD—left their positions for the private sector after 1991. The bulk of this outflow, however, occurred in the early 1990s, a pattern that was also evident in the nuclear and missile complexes. The Carnegie Endowment study indicates that a small but significant number of weapons specialists began moving to the private sector in 1992, but the outflow soon peaked—in 1993 for the missile complex, and in 1996 for the nuclear weapons industry—and then rapidly declined. Although some of the scientists and engineers who left the defense complex for the private sector fared well, others did not. By the end of the 1990s, as economic hardship and turmoil in Russia remained acute (and showed no signs of abating in the near future), the number of weapons scientists who were inclined to venture into the private sector had greatly diminished.

It is unlikely that the situation will improve before the projected cuts in the Russian WMD complexes are due to take effect. Russian investment in technology commercialization is less than \$200 million a year, and

foreign direct investment in science and technology in Russia is still almost nil. The WMD specialists who are still working in the Russian weapons complexes will therefore be extremely reluctant to forsake their posts. The younger scientists and engineers who were inclined to leave for opportunities in the private sector have already done so, and the remaining weapons personnel will find it especially difficult to adapt to new lines of work.

OFFICIAL RUSSIAN EFFORTS TO FORESTALL A NEW BRAIN DRAIN

Until very recently, the Russian government had sought to forestall the emigration of key WMD scientists, engineers, and technicians by imposing severe travel restrictions on individuals who enjoyed access to “state secrets.” This punitive approach is still in effect, but since early 2000 the government has also increasingly tried to offer a carrot (more attractive career opportunities) to go with the stick. Although the stick will undoubtedly remain crucial in preventing undesired emigration, the effort to adopt a more nuanced, carrot-and-stick approach suggests a recognition that the stick alone will not be effective over the long run.

Proposals to Improve Russian Science and the Weapons Complex.

Even before Vladimir Putin took over from Yeltsin as Russian president at the end of 1999, he had displayed a keen interest in bolstering Russia’s scientific research capabilities, especially research on nuclear weapons and other advanced military technologies. In late April 1999, when Putin was Secretary of the Russian Security Council, he played a crucial role in the Council’s adoption of a classified directive authorizing sharp increases in the salaries and benefits of nuclear weapons scientists and engineers. At a news conference after the Council met, Putin hailed the resolution as an “urgent measure” that

would “ensure the stable functioning of the nuclear weapons complex.” He expressed a similar view 4 months later, shortly after he became prime minister. At a ceremony marking the 50th anniversary of the first Soviet nuclear bomb test, Putin declared that “Russia’s nuclear weapons complex is the foundation of our country’s security,” and he vowed that “the development and upkeep of the nuclear weapons complex will remain the state’s highest priority.”

After gaining the presidency, Putin continued to emphasize the need for major improvements in Russia’s scientific prowess and weapons research. In a speech before a group of scientific workers at the science research park in Zelenograd in early February 2000, he called for “a comprehensive reform of the scientific and technological sphere,” attributing the problems in Russia’s scientific establishment to past mismanagement and waste. Although he lamented the earlier loss of highly trained scientists and engineers, he declared that his policies would prevent any further brain drain. A month later, Putin abolished the Ministry of Science and Technology along with several other federal agencies and replaced them with a much larger Ministry of Industry, Science, and Technology, which oversees a vast network of weapons research and testing facilities. Putin’s choice of a high-ranking official from the military-industrial complex, Aleksandr Dondukov, to head the new ministry was a further sign of the growing emphasis on weapons-related research.

Putin highlighted this theme in two important speeches in late March 2000 just before and just after he was formally elected president on March 26. In the first speech, delivered at the All-Russian Conference of Employees of the Defense-Industrial Complex, he pledged that “defense production, as a core part of the overall economy, will be the driving force of industrial development.” In the second speech before an enlarged session of the Minatom Collegium in Snezhinsk, Putin promised to “strengthen Russia’s nuclear weapons complex” and to ensure that “the

significance of this complex, far from decreasing, will increase exponentially.” He stressed that Snezhinsk and the other nuclear weapons facilities would be at the heart of his scientific research program:

We must make 100 percent use of the intellectual riches of [the nuclear weapons] industry and must support its unique collectives, laboratories, and scientific centers. They are the source of innovative technologies for all of our industries, and they are the resource for economic growth and for the successful development of the country.

Putin returned to these points on numerous occasions in both 2000 and 2001. In May 2000 he delivered a keynote address before the general assembly of the Russian Academy of Sciences, an annual event that Yeltsin had always declined to attend. In his speech, Putin called for a “comprehensive reform of the scientific-technical sphere” that would enable Russia to “make maximum use of the immense scientific and technical resources and highly-trained personnel of the military-industrial complex.” Three months later, he met with 20 senior members of the Russian Academy of Sciences to discuss the future of the Russian scientific establishment. Putin decried the “brain drain that has eroded our state’s potential in the world” and vowed to improve the conditions for scientific research. In particular, he promised to devote greater resources to areas vital for national security, especially nuclear weapons and other high-technology industries.

To reinforce this new approach, Putin’s ministers provided more funding for science in 2000 than was actually promised in the federal budget, a striking reversal of the pattern in 1992-98, when outlays for science consistently fell short of the projected level. The government also revised the science budget for 2001, allocating an additional 820 million rubles toward salary increases for scientists, 800 million rubles to improve research facilities, 12.5 million rubles to provide for scientists’ housing needs, and 80

million rubles for other “retention efforts.” In addition, Putin secured funding for a new state training plan for scientific and engineering personnel, with particular emphasis on the defense industry. As a further gesture of support for the weapons complex, Putin pledged to confer privileged tax and legal status on the “science cities” (*naukogrady*), the 60 or so defense-oriented research metropolises that had flourished during the Soviet era but had fallen on hard times in the 1990s. Putin also proposed a fourfold increase in grants for university science departments engaged in weapons-related research and 30-40 percent increases in salaries for lecturers in those departments. (Traditionally, Russian universities other than Moscow State and Leningrad State had been much less important than the Russian Academy of Sciences in carrying out basic scientific research, but the research activities of many of the universities were expanded significantly beginning in 1997.)

Putin’s emphasis on the military applications of science has caused anxiety among some Russian scientists, who worry that the new policies are little more than a reversion to the centralized, top-down system of the Soviet era. In mid-2000, the St. Petersburg Association of Scientists condemned the government’s alleged efforts to convert science into a “branch of the military.” Even many of the scientists who were more favorably disposed toward Putin’s proposals were initially skeptical that the new rhetoric and policies would be sustained over time. In the hope that a real change was in the offing, they offered suggestions about how to improve the situation in the near term. In public interviews and discussions with senior officials, a number of leading scientists complained that the government’s efforts to provide housing and monetary incentives to retain existing personnel and lure scientific researchers back to Russia had been far too limited. They also stressed that the recruitment of new scientific talent would depend on ensuring career mobility as well as material inducements. Although many scientists concurred with the government’s

proposal to scale back the state's role in civilian research over time and to encourage large increases in private investment, they warned that the scarcity of private capital in Russia made it infeasible to proceed very quickly in this direction.

These concerns were taken into account by the government in its latest proposals for weapons-related research and the compensation of nuclear scientists. In August 2000, Putin issued a decree on "Urgent Measures of Social Support for Specialists of the Nuclear Weapons Complex of the Russian Federation." The decree authorized further increases in the salaries and pensions of all scientists, engineers, and other personnel involved in the "research, production, and disassembly of nuclear weapons." These new pay increases and the settlement of earlier wage arrears ensured that nuclear weapons scientists and engineers would be receiving salaries roughly two to three times higher than average, along with generous benefits. Two days after issuing this decree, Putin sent Prime Minister Mikhail Kas'yanov on a highly publicized visit to the VNIIEF nuclear weapons design center in Sarov. During the trip, Kas'yanov pledged that the government would upgrade the living standards and research conditions of employees in the nuclear weapons complex. "The development of science pertaining to nuclear weapons," Kas'yanov declared, "is one of the main objectives for Russia."

The government's efforts to bolster the scientific prowess of the weapons complex continued in 2001. As the year began, the Sarov and Snezhinsk nuclear research centers announced that they would be embarking on new state-funded defense projects and providing additional pay increases for essential personnel. Other key weapons facilities made similar announcements, and the government proposed extra funding for new military research activities. In the spring of 2001, Putin established a Science Council under his direct supervision to "choose the priorities for scientific research" in Russia and to facilitate a

“reversal of the brain drain” by encouraging the “best scientific personnel to come back” to their homeland. When the Science Council advises Putin how “the state should support fundamental science and applied science,” it is supposed to give particular weight to defense-related programs in “cutting-edge areas on which the future of the country depends.”

Putin’s emphasis on the link between scientific research and military production was reinforced in October 2001 when he upgraded the ministry of industry, science, and technology and tied it directly to the defense complex. In an unexpected move, Putin replaced the existing minister of industry, science, and technology, Aleksandr Dondukov, with Ilya Klebanov, a deputy prime minister who had been overseeing the roughly 2,000 military-industrial enterprises in Russia. Although Klebanov was removed from his post as deputy prime minister in February 2002 (largely because of political infighting), he was able to combine the two posts long enough to ensure that the ministry of industry, science, and technology (or, more likely, a successor body controlled by the Russian Security Council) would be responsible for overseeing a long-awaited overhaul and upgrading of the weapons complex. A draft program to this effect, released in March 2001, envisaged the establishment of 36 conglomerated “corporations” as conduits between the government and the large array of defense plants. Many observers expected that this program, like numerous others over the past decade, would come to naught. But now that Klebanov’s position has been strengthened and the science establishment has been effectively subordinated to the defense complex, the prospects for meaningful change may be greater, especially if economic growth continues and the federal budget remains in surplus.

Until the Russian economy is drastically reformed (a process that is still in its early stages) and free-market institutions are firmly in place, the conditions for scientific research in Russia will remain precarious. But if Putin’s

proposals to revive the country's scientific and technological capabilities can be converted from rhetoric into sustained action, they will clearly benefit the defense complex. Whether that will be good or bad from the West's perspective remains to be seen.

Recruitment and Retention of Younger Weapons Scientists.

To ensure that the WMD complexes remain vigorous in the future, Putin has sought to increase the number of young, highly trained scientists and engineers who undertake weapons work. The influx of younger scientists to the weapons facilities had dropped significantly in the first half of the 1990s, primarily because the collapse of the Soviet Union led to the breakdown of the centrally planned higher education system in Russia, which traditionally had channeled many of the best young scientists from leading universities (the Moscow Institute of Physics and Engineering, the Moscow Institute of Physics and Technology, Moscow State University, Leningrad State University, etc.) to the WMD complexes. Similar problems arose during this period with the recruitment of newly trained engineers. In the past, most of the engineers employed in the nuclear weapons complex had been educated at the seven specialized universities (branches of the Moscow Institute of Physics and Engineering) and 18 technical schools in the closed cities that were run by the Soviet Ministry of Medium Machine-Building (and later by Minatom). Funding shortfalls of nearly 75 percent at the Minatom universities and technical schools from 1992 to 1997 deterred prospective students from enrolling. The result was a further reduction in the flow of freshly trained specialists to the WMD complexes. Initially, this trend did not pose a serious problem for staffing levels within the weapons complex—a survey by Minatom in early 1999 found that over 90 percent of key positions and areas of expertise in the nuclear weapons industry were filled—and indeed some cuts in the supply of new personnel were

needed to facilitate the projected downsizing of the nuclear complex. Nonetheless, a continued failure to attract sufficient numbers of younger scientists and engineers would pose grave long-term problems for the weapons facilities. Hence, one of Minatom's chief priorities since the late 1990s has been to step up the recruitment of younger scientists and engineers and to retain those who have recently joined the nuclear weapons facilities.

The goal of encouraging younger scientists to enter the defense complex has also been a constant theme of Putin's policies and statements. In May 2000, he called for a "national program to draw young people to science," an allusion to the possible restoration of an educational system that would allocate fresh scientific talent to military research. In late November 2000, at Putin's behest, the government convened a special meeting to discuss how to ensure that younger scientists would pursue research careers within Russia, especially in the defense complex. Several of the participants warned that unless sweeping measures were taken, younger scientists would increasingly seek to enter the commercial sector or, even worse, to immigrate to the West. The reduced flow of young scientists into the weapons complex, according to those present, was posing a "threat to [Russia's] security." The minister of education, Vladimir Filippov, expressed particular concern that "the United States has set a target to attract specialists in the field of science and the defense industry, which includes a special quota for Russian experts. If we do not take urgent steps, we will be working for another country's defense." These concerns helped spur Putin's proposals to quadruple the funding for defense-related research at universities and to improve opportunities available to younger scientists.

Other steps to recruit young scientists and engineers have been taken by Minatom itself, notably through its sponsorship of events for groups of younger experts, its allotment of greater funding to the specialized universities and technical schools in the closed cities, and its success in

obtaining draft exemptions for young specialists who make their careers in the nuclear weapons complex. Beginning in 1999, the section for young people in Russia's Nuclear Society (a professional organization closely affiliated with Minatom) sponsored and participated in periodic scientific conferences and annual youth congresses for freshly recruited experts working in the nuclear complex. In March 2000, a group of younger scientists and engineers employed at VNIIEF formed a youth council, which is intended to represent the interests of some 1,500 younger experts at the nuclear center. With Minatom's approval, similar councils have been set up at other nuclear facilities.

The upgrading of the specialized universities has been facilitated not only by increased funding for training and laboratory equipment, but also by the establishment of generous scholarships to attract bright students. Since the late 1990s, several dozen scholarships have been awarded each year to students at all seven universities. Another important development has been the creation of special departments and divisions in which courses are taught by senior scientists and engineers from the local nuclear weapons facilities. The degree program takes 6 years to complete, but, beginning in the third year, students are given the opportunity to pursue apprenticeships and to use laboratory equipment at the weapons facilities. Further training is available in 29 postgraduate science and engineering programs, with an enrollment of around 450 a year.

These improvements, and the increased enrollments that have resulted, have been reinforced by Minatom's ability to secure draft exemptions for younger employees of the nuclear weapons complex. Because severe hazing and other abuses in the Russian army remain pervasive, many young people in Russia have been eager to avoid conscription. At Minatom's urging, Putin issued a decree in November 2000 granting exemptions from military service to hundreds of young scientists and engineers at the Sarov, Snezhinsk, Lesnoi, and Trekhmogor'nyi nuclear weapons

facilities. The exemptions remain in effect as long as the beneficiaries continue to work full-time in the weapons complex. This privilege offers a major incentive for talented young people to pursue careers either at weapons facilities or, under a separate decree, at civilian nuclear plants.

All these developments have led to a significant increase in the number of young specialists who are entering the weapons complex. After reaching a low point in the mid-1990s, the number of new employees recruited by Minatom rose to 2,000 in 1998, dipped to 1,500 in 1999, and then rose back above 2,100 in both 2000 and 2001. Although certain problems persist at Minatom's educational facilities and many young people in the closed cities are still seeking to move elsewhere, the dire predictions that some observers (including some senior Minatom officials) made in the mid-1990s about the growing dearth of fresh talent for the nuclear weapons complex seem less relevant since the late 1990s. For the time being, a gap remains in the lower-level staffing of the weapons facilities—a gap that resulted from the greatly reduced inflow of younger scientists and engineers in the first half of the 1990s—but there is ample reason to believe that this gap can be overcome if recruitment stays relatively buoyant and Minatom proceeds with a restructuring of the nuclear complex.

Travel Restrictions and Curbs on Foreign Contacts.

Of all the factors that limited the brain drain from Russian WMD facilities to foreign countries over the past decade, perhaps the most important was the existence of travel restrictions. The restrictions were first imposed during the Soviet period and were reaffirmed in the 1990s by Russian legislation, government directives, and presidential decrees. Under these measures, the Russian government is able to forbid individuals who have had access to "state secrets" from leaving the country for a period of 5 years after their last contact with such information. The

government is also entitled, at its own discretion, to extend the period for as long as deemed necessary.

Legal restrictions on the foreign travel of weapons specialists had been in place from the moment the Soviet WMD programs were set up, but the dissolution of the Soviet Union in December 1991 raised the question of what to do about those restrictions. For decades, foreign travel for all Soviet citizens had been severely limited and controlled by the state, but in May 1991 the Soviet parliament approved a measure titled Law on the Order of Departure from and Entry into the USSR of Citizens of the USSR, which significantly liberalized the earlier travel regime. Because the Russian Federation initially lacked its own law governing the entry and exit of citizens, the Russian government simply extended the Soviet law, which remained in effect until the Russian parliament finally passed a new law in mid-1996. A resolution adopted by the Russian government in late January 1993 reaffirmed and tightened the Soviet law's restrictions on "individuals who are privy to state secrets." The resolution stipulated that organizations intending to send employees abroad on official business had to check first with the state security apparatus to determine whether there were "grounds for temporary restrictions on the [employees'] right to leave the Russian Federation." This provision applied to all employees of the WMD complexes, and the coverage was broadened through amendments to the resolution in 1993 and 1995, which explicitly empowered the head of the Kurchatov Institute (a leading nuclear physics research institute) and the director of Biopreparat (the BW pharmaceutical firm, which had been converted into a "joint-stock company") to restrict the foreign travel of their employees as well, in consultation with the state security organs. No maximum duration was set for these restrictions.

The limitations on foreign travel were tightened further in July 1993, when the Russian parliament adopted a long-awaited measure titled Law on State Secrets. The law

replaced (or in some cases supplemented) Soviet-era legislation that had been extended via a Russian presidential decree in January 1992. Article 5 of the new law and the more detailed provisions of a subsequent “List of Items of Information Classified as State Secrets” make clear that all technologies, components, and procedures connected with “weapons of mass destruction, that is, nuclear, chemical, biological, or other weapons of great destructive force,” are state secrets “of special importance” (*osoboi vazhnosti*), the highest level of classification. (A three-tiered classification system is laid out in Article 8 of the Law on State Secrets and in the more elaborate rules of classification adopted by the Russian government in October 1995. Under these rules, classified information is deemed to be “secret,” “top secret,” or “of special importance”—a division that is broadly similar to the secrecy categories used during the Soviet era.) The expansive definition of “secrets” in the law allows the security organs to prevent vast numbers of people, including all weapons scientists and engineers, from going abroad.

The most severe restrictions on travel by WMD specialists are laid out in Article 24 of the Law on State Secrets, which requires anyone working with information “of special importance” to forfeit “the right to go abroad until after a period specified in the [employee’s] labor contract.” Labor contracts for weapons specialists include detailed provisions forbidding disclosure of classified information and a special provision compelling each employee to “agree to a partial, temporary restriction of my rights, including the right to travel abroad for a period of ____ years,” with the precise length of this period determined by the employee’s rank and duties. The contracts stipulate that even if the employees lose or relinquish their access to state secrets, they must continue to abide by the obligations they “voluntarily undertook,” including their acceptance of restrictions on all foreign travel.

In principle, the limitations apply only to travel outside the country, but in practice the leeway for key WMD specialists to move around **within** Russia is also still tightly controlled. During the Soviet era, employees of the closed cities were not permitted to travel anywhere (even to other Soviet cities) unless they received official permission. After 1991, the ban on traveling and moving to other cities was supposed to have been eased, but in practice it remains in effect, as Vladislav Mokhov, a senior nuclear weapons physicist at Sarov, emphasized in mid-1996:

I work on secret projects and am therefore restricted. . . . But if I could choose my place of residence [within Russia], I would never have stayed here [at Sarov]. Unfortunately they would not let me leave. If given a choice, most of us theoreticians would go to Moscow.

Enforcement of the travel restrictions is provided for in Article 20 of the law, which authorizes the Russian president to establish an Interdepartmental Commission for the Protection of State Secrets, a body with “extra-departmental powers” to coordinate all activities needed to “protect state secrets.” Yeltsin issued a decree in November 1995 that formally set up the Interdepartmental Commission and another decree in January 1996 that specified the organization and functions of the Commission, including its role vis-à-vis foreign travel. The powers of the Commission and other agencies to limit travel are laid out in greater depth in the Federal Law on the Procedure for Exiting and Entering the Russian Federation, which took effect in August 1996. The law grants wide discretionary authority to the state security organs and the Commission to prevent individuals who have had access to state secrets from leaving the Russian Federation. Under Article 15, anyone who has had access to secrets “of special importance” and has “signed a labor contract providing for the temporary restriction of his right to exit from the Russian Federation” can be denied the right to leave Russia, no matter what the purpose of the intended trip. The law thus further codified the basic restrictions described by

Yurii Tumanov, the first deputy director of the Sarov nuclear weapons center, in April 1995:

People involved in secret research must go through a rigorous screening by the Federal Security Service [FSB] if they want to travel abroad. The FSB determines the extent of their knowledge of state secrets. Those who are most closely involved in secret research are not permitted to take private trips abroad. . . . Scientists who are privy to information of special importance are not allowed to go abroad even as members of official delegations unless they receive personal permission from the minister of atomic energy.

The initial length of the restriction is 5 years from the time of the employee's most recent contact with classified information "of special importance," and the Interdepartmental Commission is permitted to extend the term for at least another 5 years.

Some of the weapons scientists who have applied to leave Russia either temporarily or permanently were granted permission to do so, but those whose requests were denied were informed by the "internal security organs"—under Article 16 of the Law on the Procedure for Exiting and Entering—of the date of the denial, the registration number of the case, and the full name and legal address of the organization principally responsible for the denial. Unsuccessful applicants are given the right to appeal the restrictions before an Interdepartmental Commission for the Consideration of Appeals by Citizens of the Russian Federation in Regard to the Limitation of Their Right to Exit from the Russian Federation. This appeals commission was set up via a government resolution in March 1997 as a direct replacement for the Interdepartmental Commission for the Consideration of Appeals by Citizens of the Russian Federation Relating to the Denial of the Issuance of a Foreign Passport and Temporary Restrictions on Travel Abroad, which had been established by a government directive in March 1993. The new commission is obliged to respond to all appeals within 3 months.

The regulations for the appeals commission stipulate that it must supply the Interdepartmental Commission for the Protection of State Secrets with an applicant's pertinent travel documents whenever there is "a need to extend the period of restriction on a citizen's right to exit from the Russian Federation beyond 5 years as provided under [the citizen's] labor contract." The Interdepartmental Commission on State Secrets must then issue a ruling on whether the information to which the applicant had access was truly "of special importance." If the appeal is turned down, the individual can appeal it further in a court of law. In the meantime, however, anyone who has been denied permission to leave the country must immediately relinquish his or her passport and all other travel documents "for safe keeping to the state body that issued the passport."

This appeals procedure, cumbersome though it is, was used surprisingly often in the mid-1990s by scientists who were denied permission to leave the Russian Federation because they had been privy to state secrets "of special importance." From June 1994 to June 1995, the appeals commission (known informally as the Ivanov Commission after its chair, Igor Ivanov, who was then a first deputy foreign minister) heard appeals in 198 such cases. The commission rejected 16 of the appeals and, in each case, imposed an additional period of up to 4 years on the initial travel restriction. The appeals procedure has been invoked less frequently since the late 1990s, primarily because of the sharp drop in the number of scientists seeking to leave the country. The lower incidence of appeals is also partly due to the increasing likelihood that appeals will be rejected. As the appeals commission became more stringent in its rulings, it deterred potential applicants from even trying.

Violations of the law on the right to leave the Russian Federation are punishable by up to 10 years of imprisonment, the same sentence that is meted out for violations of the travel provisions in the law on state secrets. Western legal scholars and government officials, as well as

human rights groups in both Russia and the West, have argued that the Russian laws are excessively broad and open-ended, and that the severity of the restrictions inevitably circumscribes the rights of scientists who pose no threat of strategic proliferation. The potential for abuse was underscored by a case in 1999 involving Raisa Isakova, a former scientific researcher at a secret institute in Omsk who had held a Grade 2 security clearance. Isakova had long been active in the local Jewish community, and in March 1999 she applied for permission to travel to Israel. After several weeks of delay, the Federal Security Service (FSB) warned her that unless she signed a compromising statement against the Jewish Agency in Russia (a nongovernmental organization that promotes immigration to Israel), her application for an exit visa would be turned down. Isakova was the head of the local branch of the Jewish Agency in Russia, and she refused to sign the statement. Her application was then rejected, and she was informed that she would not be able to receive a visa until at least December 2005. She appealed the decision, pointing out that numerous other researchers from her institute with the same level of security clearance had been permitted to travel abroad. In September 1999 the appeals commission ruled that she could reapply for a visa in January 2003 (rather than December 2005), but it did not overturn the denial of her application.

Isakova's experience is one of several cases that reflect the government's increasing determination to curtail foreign travel by individuals who have had access to state secrets. (The Isakova case is also indicative of the persistence of official anti-Semitism, but that is another matter.) The potential for abuse by the Russian authorities has sparked wide concern among scholars, human rights advocates, and legal specialists in both Russia and the West. Some have argued that the restrictions are not only repressive, but counterproductive for the Russian government itself. According to this view, the emigration of certain individuals who were denied the right to leave could

actually have proven beneficial to Russia by reducing the potential for discord at home.

These sentiments, however, are not shared by senior FSB officials who, in early 1996 when the law on the right to exit the Russian Federation was being debated, claimed in interviews with the Russian news media that restrictions on emigration of Russian scientists are crucial to protect the Russian state from foreign subversion. As one official put it, “Anyone who has had access to state secrets . . . must forfeit the right to travel abroad, except on official business. Such measures are needed to ensure that hostile forces will not compromise our security.”

This draconian view has been endorsed by high-ranking officials in Russia’s military-industrial complex, who have even complained that the current laws on state secrets and emigration are too lax, a view that Putin himself expressed at Zelenograd in February 2000. In November 2000, amid controversy surrounding the arrest and trial of the retired American intelligence officer Edmond Pope, several prominent Russian weapons scientists sent an open letter to the leaders of the Russian government and judiciary alleging that measures to permit greater openness and freedom of travel were endangering the country’s scientific establishment and compromising state secrets. The scientists echoed Putin’s call for more stringent laws that would ward off “hostile encroachments” on Russian science. They asserted that “the proper balance between secrecy and openness” had shifted too far in favor of the latter and that “court hearings [connected with appeals of travel restrictions] are depriving the [Russian] state of the right to defend itself against breaches of its security resulting from the disclosure of state secrets.” The scientists stressed that the increased freedom of travel both into and out of Russia was allowing foreigners to take unfair advantage of Russian scientists:

Russia has a lot of things in the military, technical, and scientific areas to be proud of and a lot to protect against

uninvited “guests.” These guests try to exploit our openness, our economic difficulties, and the mercenary interests of certain representatives of the military-industrial complex to obtain Russian know-how and state-of-the-art technologies for next to nothing.

The Pope case inspired many other officials to express similar views. The deputy leader of Putin’s Unity faction in the Russian Duma, Frants Klintsevich, condemned the “devil-may-care attitude to the defense of state secrets” and demanded that the freedom of travel—both within Russia and outside it—be restricted. The chair of the Duma’s subcommittee on security and disarmament, Vitalii Sevastyanov, denounced the “imperfections and flaws in the Russian laws on state secrets” and called for “tough measures” to prevent the compromise of “technologies developed by generations of Russian scientists and the defense industry—technologies that are the national treasures of Russia.” Although Sevastyanov’s remarks were directed mainly against foreigners operating within Russia, he stressed that the emigration of Russian weapons scientists was posing an equally dire threat. The alleged “danger” resulting from the emigration of Russian scientists was emphasized even more explicitly in the Russian press, which decried the FSB’s supposed failure to halt the brain drain and the concomitant leakage of Russian military technology. In a typical case, a commentator in the widely circulated daily *Moskovskii Komsomolets* accused Western nonprofit foundations—specifically naming Soros, Carnegie, Fulbright, MacArthur, Friedrich Ebert, and Eurasia—as well as the ISTC and the U.S. Agency for International Development of being “sieves” that were luring unemployed Russian scientists to the West.

Even before the Pope case erupted, there were ample signs that the brief period of relatively free emigration in the early 1990s had given way to much tighter restrictions. Siegfried Hecker, who was instrumental in setting up the Russian-American nuclear laboratory contacts in early 1992 when he was director of Los Alamos National

Laboratory, recently noted that by the late 1990s “the nuclear defense sector [in Russia had] experienced a significant reversal of the openness we found in the early 1990s. The rise in the presence and power of the Russian security services was felt by all nuclear installations.” As far back as October 1995, a detailed set of instructions approved by the Russian government on the procedures for granting access to state secrets had required all Russian citizens holding security clearances to undergo new background checks if they got married, had a close relative who moved abroad, or experienced other changes in their lives. In subsequent years, the FSB tended to construe this provision as expansively as possible. In 1998 Susan Eisenhower wrote that her husband, the well-known Russian planetary scientist Roald Sagdeev, had recently been subjected to “an extensive and thorough background check” after his passport expired. Sagdeev had formerly held security clearances, but the reason he was forced to undergo a background check was simply that he had been traveling back and forth between Russia and the West. Eisenhower noted that in recent months Sagdeev had found “border control” in Russia to be “much tighter” than in the early 1990s, and that he had heard from scientists working in the nuclear weapons and missile complexes that they too were “under far greater scrutiny” and were “restricted in their travels” and deprived of “the right to keep a passport for foreign travel in their possession.”

The increasing severity of the travel restrictions inevitably took its toll. The Carnegie Endowment survey revealed that, by 1999, nuclear weapons scientists were citing “administrative restrictions” and a lack of money as the two main obstacles to working abroad. Many of the scientists argued that “the authorities do everything to prevent a person from going abroad” by “imposing conditions . . . and putting obstacles in the way.” The tighter restrictions on foreign travel were by no means the only factor that led to a sharp drop in the rate of emigration after the early to mid-1990s, but they clearly played a crucial role.

Because Russian weapons scientists knew they had to overcome formidable barriers before they could leave the country, they often sensed that it was better not to try. The small number who did apply to travel abroad were often turned down.

Moreover, the clampdown on scientists eventually extended beyond the tightening of travel restrictions to include limitations on all foreign contacts, even the most innocuous ones. In May 2001, the presidium of the Russian Academy of Sciences issued a directive outlining “Measures to be Taken by the Russian Academy of Sciences to Prevent Damage to the Russian Federation.” The directive required the Academy’s “special departments” (*osobyie otdely*) and institute directors to “exercise constant control over trips abroad by Academy of Sciences researchers who have access to state secrets,” to “tighten control over the researchers’ submission of reports about their trips abroad,” and to compel researchers to disclose any projects they were pursuing with foreign scientists, any grants they might seek from abroad, any articles they published in foreign journals, any visits they might host by foreign scientists, and any other contacts they might have with foreigners. The information was to be collected and transferred periodically to “appropriate officials” in the government.

Controls of this sort had been in effect during the Soviet era, but most of them were lifted after the Soviet Union disappeared. The rationale for restoring them, according to the government and senior Academy officials, was to “protect state secrets” and prevent any “leakage of scientific information.” One of the vice presidents of the Academy, Gennadii Mesyats, argued that “it is of immense importance to preserve our know-how” in the defense sector. He claimed that the “increased freedom of contacts with foreign visitors” had posed serious risks:

Many Russian scientists [in the 1990s] went abroad to earn money, and the directors of scientific research institutes, if only reluctantly, began selling off the results of projects that were

not attracting investors within Russia. As a result, not only was the [earlier policy of] total control over foreign contacts lost. For a while these contacts were not subject to any control at all. The leakage from the country of information about promising scientific developments took on a catastrophic nature in some places.

Mesyats and other senior Academy officials also insisted that the revived controls were no different from those supposedly in effect in the United States and other Western countries. The Academy's chief press representative, Igor Milovidov, argued that "it is a universally customary practice to report to your boss" about contacts with foreigners, and Mesyats added that he had "frequently been on official trips to the United States, and they have a very tough secrecy regime. . . . I know that U.S. scientists also inform their bosses about absolutely everything. There is nothing underhanded here [in Russia]. No! This is normal." Although it is true that scientists at U.S. weapons laboratories and other highly sensitive facilities are obliged to keep their superiors informed of foreign contacts, Mesyats is wide of the mark in suggesting that expansive controls like those in Russia, applying to civilian and weapons scientists alike, would or could be adopted in the United States.

The crackdown on civilian scientists, combined with the Russian government's decision in September 2001 to establish a new Agency for the Protection of State Secrets that will "impose tighter limits on information security," suggests that the ever more stringent controls on weapons scientists are unlikely to be eased anytime soon. The increased salience of the FSB under Putin, and the Russian news media's and government's growing obsession with allegations of "foreign espionage" against Russia, imply that the trend, if anything, is likely to be toward even stricter, not looser, control over the travel and foreign contacts of weapons scientists. Should this prove to be the case, it may well derail any notion of encouraging these scientists to immigrate to the West.

CONCLUSIONS

Several points that emerge from the analysis above have a bearing on U.S. policy vis-à-vis Russian weapons scientists.

First, compared to the sharp reductions in Russia's output of conventional weapons, Russian facilities for the production of WMD have been only modestly scaled back. Even now, more than a decade after the collapse of the Soviet Union, most of the infrastructure for the Soviet nuclear weapons and CBW complexes is still in place. A very large group of highly trained weapons scientists and engineers—numbering tens of thousands—are still employed at Russian WMD facilities and are still engaged in weapons-related work.

Second, the departure of Russian civilian scientists in the early 1990s—either to foreign countries or to nonscience jobs within Russia—took a toll on Russian scientific prowess, but the brain drain did eventually subside. By the late 1990s, far fewer scientists were seeking to emigrate. Within the WMD complexes, the brain drain phenomenon was much less acute, contrary to Western fears in 1991 that the demise of the Soviet Union would spawn a mass exodus of senior weapons scientists to Third World countries pursuing WMD programs. In reality, only a minuscule percentage of highly trained weapons experts actually left, especially after the early 1990s. The best of the nuclear weapons scientists were never interested in working abroad, and recent surveys have shown that very few other senior WMD specialists nowadays are inclined even to think of moving overseas.

Third, the United States has accepted some civilian scientists from the former Soviet Union as permanent residents (mostly in the early 1990s), but has made no effort to induce former Soviet weapons specialists to immigrate en masse to the West. Instead, U.S. policy has been geared mainly toward providing meaningful employment for

Russian and Ukrainian WMD experts in their native countries. The only modest exception came in 1992 with the Soviet Scientists Immigration Act (SSIA), which was intended to cover only about 1 percent of the WMD scientists in Russia who were of greatest proliferation concern. The SSIA was subsequently hindered by administrative delays and was a source of tension with Moscow. The problems that arose with the SSIA militated against any larger-scale attempts to encourage the immigration of former Soviet WMD scientists to the West.

Fourth, U.S. and other Western efforts to provide alternative employment for the most highly trained WMD scientists in the former Soviet Union have been well-intentioned, but have not achieved the desired effect. The scale of the problem is much too large for any of these programs to have any meaningful impact. (This would be the case even if the U.S. programs were well designed. The DOE's dubious judgments about certain matters greatly compound the problem.) Only a relatively small percentage of high-level Russian weapons scientists have actually taken part in the Western-sponsored projects, and the overwhelming majority of the participants have devoted only a small percentage of their time to the projects. During the rest of their time, the Russian scientists have continued to perform weapons-related work. Once the outside projects are over, the scientists have returned full-time to their WMD work. The Western programs thus have not provided—and cannot provide—a permanent alternative source of employment for tens of thousands of highly trained Russian WMD specialists. Indeed, there is even a risk that the Western programs have inadvertently become a subsidy for the Russian WMD complexes, helping to keep them operating at a robust level.

Fifth, the private sector in Russia has absorbed some former weapons scientists, but it is hardly a panacea. Even in Western countries, defense conversion is extremely difficult. In Russia, the problems are immeasurably greater not only because the country was so highly militarized

under the Soviet regime, but also because efforts to reform the Russian economy have been so disappointing. Moreover, even if the private sector in Russia were thriving (which is not yet the case, especially outside Moscow and St. Petersburg), it is unlikely that most of the highly trained WMD scientists would be well-suited to enter it. The younger scientists who could adapt more easily to the rigors of a private labor market have already left, and the senior specialists who are still working at WMD facilities would have inordinate difficulty in adapting.

Sixth, the Russian government's recent attempts to upgrade Russia's scientific capabilities, especially in the defense sector, may mean that the long-anticipated restructuring and downsizing of the Russian WMD complexes will be delayed or reduced in scope. Despite Minatom's projections of sizable layoffs in the nuclear weapons complex over the next several years, recent trends suggest that a large number of the senior weapons scientists can count on keeping their jobs for a substantial time to come, especially if the Russian economy continues to grow and the Russian federal budget remains in surplus. The stepped-up recruitment of younger weapons scientists also implies that WMD facilities will be operating at a robust level well into the future.

Seventh, restrictions on the travel of Russian weapons scientists have contributed to the sharp decline of interest among scientists in the prospect of working abroad. The laws on state secrets and on exit and entry, and the stern implementation of those laws by the FSB, pose a formidable—indeed almost insuperable—barrier for any senior WMD scientist who might seek to emigrate. Awareness of these obstacles would likely deter a would-be emigrant from seriously pursuing the option. Illegal emigration cannot be ruled out altogether, but there is no reason to believe that it would occur on anything more than a trivial scale, if that. Very few Russian weapons scientists are inclined any longer to think about working abroad (even legally, not to mention illegally), and they are certainly

aware of the severe penalties for those convicted of violating the laws on state secrets and on exit and entry.

Eighth, neither Yeltsin nor Putin displayed any willingness to permit freer travel by WMD specialists. The debate in Russia was settled early on in favor of those who believe that a brain drain—especially one involving weapons scientists—is inherently a negative phenomenon. In the early 1990s, a small number of Russian officials, notably the minister of science, technology, and higher education, Boris Saltykov, were willing to countenance scientific immigration to the West because they believed that it ultimately would prove beneficial for Russia. Saltykov claimed that leading scientists would go abroad temporarily and would return to Russia having been “enriched by the experience and skills of the best laboratories in the world.” This line of argument, whatever its merits, never attracted any appreciable support. The dominant view among Russian officials, journalists, and political commentators was that a further exodus of civilian scientists—not to mention the departure of highly trained weapons experts—would be detrimental to Russia’s interests and should therefore, to the extent possible, be prevented. Although a small number of WMD scientists were sent abroad on temporary assignments (including possibly to Iran), the Russian government gave no indication that it would allow many thousands of highly trained weapons specialists to move permanently overseas.

All of these considerations present a sobering outlook for any prospective U.S. effort to encourage the immigration of roughly 60,000 senior Russian WMD specialists to the West. If judged in terms of **desirability**, the option of promoting immigration to the West would clearly be the route to go. Tens of thousands of key weapons scientists, engineers, and technicians are still at their posts in Russia, where they have been helping to sustain the Russian WMD complexes through troubled times. To the extent that Russia would be a lot better off—and would pose a much smaller potential threat to U.S. interests—if it drastically

scaled back its nuclear weapons complex and did away with its CBW facilities, the continued presence of these tens of thousands of highly trained weapons experts in Russia is detrimental for the West. Up to now, the Russian government has been unwilling to dismantle its WMD infrastructure, and recent trends suggest that this aversion is likely to persist. The only reliable way to ensure that Russia would have to make drastic cuts in its WMD facilities is by permanently removing the most important researchers and engineers who work at those facilities—an outcome that immigration to the United States would achieve. The opportunities that the newly arrived specialists would be given in the United States would, in principle, eliminate any possible incentive they might have to consider working for a country like Iran or Libya. Despite the tightening of U.S. immigration procedures in the wake of the September 2001 terrorist attacks, the option of bringing many thousands of former Soviet WMD experts to the United States would be well worth pursuing if it seemed likely to succeed.

But if judged in terms of **practicality**, the notion of encouraging large-scale immigration to the West is dubious. Six fundamental problems would hinder any such effort.

First, the decline of interest in emigration among weapons scientists, as evidenced both in surveys and in the sharp drop in emigration since the early 1990s, would be difficult to reverse. Although a major change of policy by the West might persuade some Russian weapons scientists that they should seriously pursue the option of emigration, the majority are unlikely to be convinced. It is even conceivable that a conspicuous effort to foster a brain drain to the West would spark a nationalist backlash among WMD scientists and deter them from even considering the prospect of working abroad or leaving their weapons posts.

Second, it is extremely unlikely that the Russian government would go along with such an effort or would fail to attempt to prevent it. Saltykov's sentiments (cited above)

did not win out. Even the limited provisions of the SSIA sparked a good deal of acrimony in Moscow. The severe travel restrictions and controls that have been adopted over the past several years are indicative of the Russian authorities' desire to retain the country's senior weapons personnel. Putin's recent statements merely underscore that point. It is almost inconceivable that Western countries could circumvent the administrative and legal barriers posed by the Russian government. The situation facing the Russian government today vis-à-vis its WMD experts is fundamentally different from the position of Germany after World War II. When Germany was under the control of allied occupying forces in the mid-to-late 1940s, the victorious powers enjoyed free rein to induce (or, in the Soviet case, compel) Germany's leading weapons scientists to move abroad. Russia's relationship with the outside world today is in no way comparable. Western countries have no direct say in Russia's internal affairs, and the Russian authorities can take whatever steps they want to prevent highly trained WMD scientists from leaving. Although such measures might not prove flawless, there is little reason to believe that a massive outflow of senior weapons experts could occur against the Russian government's will.

Third, if an effort to encourage large-scale emigration proved only partly successful, the result might be decidedly negative for U.S. interests. The brain drain issue has been politically volatile in Russia and has been manipulated by anti-reformist forces to discredit reform-minded, pro-Western officials. In the 1990s, numerous commentators in Moscow argued that Russian scientists were being "exploited by the West" as "cheap labor" and "sources of information about the latest research developments" in Russia. These complaints would undoubtedly increase and become more virulent if the U.S. Government made a conspicuous effort to induce tens of thousands of Russian WMD experts to immigrate to the United States. The ensuing damage to U.S.-Russian

relations might be grave enough to prompt the Russian government to cease cooperating in key areas such as CTR, the Materials Protection, Control, and Accounting program, and the Missile Technology Control Regime. Russian leaders not only would be disinclined to defer to U.S. demands (e.g., on nuclear exports to Iran and Cuba), but might even seek to put up an active challenge to the West—possibly by offering assistance to North Korea or Iraq. Were this to be the case, the net result from a nonproliferation standpoint would be deleterious.

Fourth, in all likelihood an emigration drive that was only partly successful would have a counterproductive effect on the Russian WMD complexes. Presumably, the weapons scientists and engineers who would move from Russia would be those who had long been inclined to look favorably upon the West. They would leave behind many of their former colleagues who had always been deeply suspicious of U.S. intentions. Surveys of nuclear weapons and aerospace specialists have shown that a majority of those who want to stay in Russia are hostile to the West or at least are mistrustful. Such sentiments would undoubtedly intensify if the United States began actively luring away a large number of Russian weapons experts. The WMD scientists who would remain in Russia would undoubtedly want to expand (rather than downsize) the country's weapons facilities and to provide assistance to anti-Western clients such as Iran. By the same token, these scientists would be averse to the contacts and cooperative programs that Russian weapons scientists pursued with their American counterparts from 1992 on. Most likely, all such activities would come to a halt.

Fifth, even if a large-scale emigration drive proceeded and tens of thousands of Russian scientists flocked to the West, Western governments could not be certain that the people leaving were truly those of greatest proliferation concern. The U.S. Government does not know precisely who the most senior WMD specialists in Russia are. As the GAO recently pointed out, U.S. efforts to promote alternative

employment for key weapons personnel in Russia have had to rely on the Russian government's own judgments about the people who should be targeted:

[T]he State Department cannot independently verify the weapons experience of the senior scientists it has employed. The State Department relies on the scientists' national governments to certify that the senior weapons scientists listed as participants in a project proposal actually have sufficient expertise to pose a proliferation threat.

Hypothetically, if large-scale immigration to the West were occurring and U.S. intelligence officials and weapons scientists were given a chance to debrief the immigrants, they presumably could make a reasonably good judgment over time about the qualifications of the people who were being let in. Nonetheless, there would always be some residual concern that many of the best weapons scientists and engineers had secretly stayed in Russia.

Sixth, even if all these obstacles could be surmounted and Russian WMD specialists and their families moved en masse to the United States, serious questions would arise about what to do with the new immigrants. Limited numbers of foreign scientists and technicians could be accommodated quickly either in the private sector or at universities and research institutes, but an influx of tens of thousands (many of whom would not know English) would far exceed the capacity to absorb them, at least in the near term. Language barriers alone would pose a major obstacle to fruitful employment, as would the limited applicability (or potential irrelevance) of their skills to functions unconnected with the Soviet WMD complexes. Some of the specialists might be willing to take jobs outside their areas of expertise, but others would undoubtedly be averse to the notion of abandoning their traditional fields of work. If suitable posts for them were not soon available, they might eventually seek to leave. Presumably, the U.S. Government would need to establish a comprehensive monitoring system that would give prompt notice if former Soviet WMD experts

decided to move back to Russia or to a Third World country. Such a system, even if practical, would be difficult to sustain over time unless the movements of the scientists were sharply circumscribed, a task that would itself be daunting. Even in Germany during the early post-war years, when all residents (not just weapons scientists) had to seek permission from the allied occupation authorities to travel abroad, the Western powers occasionally let down their guard, enabling highly trained military scientists and technicians to emigrate illegally from Germany to Argentina. The challenge of enforcing a comparable system for Russian WMD experts would be at least as formidable.

In all these respects, there seems to be little to no prospect that large-scale immigration to the West by highly trained Russian WMD scientists, engineers, and technicians is at all feasible either now or over the next 10 to 15 years. The immigration of senior personnel to the West—especially if it occurred with the Russian government's assistance—would be highly desirable, but in practical terms, the whole notion seems fanciful. The likelihood is that tens of thousands of key nuclear, biological, and chemical weapons experts will remain in Russia indefinitely and will continue to pose a threat of strategic proliferation, both horizontal and vertical.

* * * * *

These conclusions may seem to offer little reason for hope, but in fact there are certain steps that could markedly improve the situation over the long term. In particular, a greatly expanded program of student exchanges would be far more practical and effective than anything that has been done up to now (or is likely to be done) vis-à-vis Russian WMD experts. Not only would a large-scale student exchange program encourage democratization in Russia and provide a sounder basis for Russia's ties with the West, it also could indirectly ameliorate the human dimension of the strategic proliferation threat. Unfortunately, student

exchanges thus far have played only an insignificant role in U.S. policy, despite the hopes of Senator Bill Bradley in the early 1990s when he put together the Freedom Support Act (FSA), which provided democracy assistance to Russia. An initial \$20 million was allocated under the FSA to a Secondary School Exchange Program (later known as the Future Leaders Exchange Program, or FLEX). Although the FSA also provided \$30 million for exchanges of undergraduates and graduate students, the high school exchange program was deemed especially important because it would involve adolescents, whose outlooks and behavioral patterns would not yet be firmly congealed. Bradley expected that some 15,000 to 20,000 Russian high school students a year would attend school in the United States and that many thousands of others would be enrolled each year in Western Europe. Exchanges of that magnitude over a decade or two would have exposed a large cohort of young people in Russia to the values, mores, and institutions of democratic capitalism.

But, as things worked out, only a tiny fraction of the projected number of Russian high school students actually came to the United States via FLEX and other programs. From 1993 to 2001, a total of just 4,415 high school students from Russia—and another 6,076 from the rest of the former Soviet Union—attended American schools under the auspices of FLEX. This means that, during the first 9 years of FLEX, fewer than 500 Russian high school students a year took part in the program. Worse still, the annual number of Russian high school students involved in FLEX was much lower by the late 1990s than it had been earlier in the decade. From 621 students in 1993 and 744 in 1994, the annual number fell to 305 by 1999—less than 1/50th of the initial target. The number enrolled in West European schools each year was even smaller.

The meager scale of the high school exchanges has been due partly to linguistic barriers. Although a large and growing number of Russian high school students know at least some English (or German), the language requirement

necessarily limits the applicant pool. In addition, many Russian high school students have been deterred from applying because their schools in Russia will not permit them to receive academic credit for the work they do overseas. FLEX has also been impeded by the difficulty of informing prospective applicants about the exchanges, a problem that is especially acute outside Moscow. The number of Russian high school students in outlying regions who enjoy regular (or even sporadic) access to the Internet is woefully inadequate. Hence, many Russian students are simply unaware of the opportunities available to them.

Serious though these problems may be, they undoubtedly could be surmounted if the United States were to devote increased resources to the effort. But a more daunting obstacle is posed by the one-sided nature of the high school exchanges. Very few American high school students have been willing to enroll in Russian schools for even a semester, not to mention a full year. Part of the problem is that only a scant number of American high school students can speak Russian. Although proficiency in Russian is not mandatory for certain short-term high school exchange programs, it obviously is required for participants in the main long-term program for American high school students—the Semester High School Exchange Program, which brought a total of 55 American students to Russia from 1993 through 2001 (an average of about six students a year). Even if language barriers did not exist, many American students would probably be hesitant about applying for a semester-long (or year-long) exchange program in Russia. Among other things, they (and their parents) would likely be concerned that a prolonged stay in Russia could pose risks for their health and well-being. Although a sizable number of American undergraduates and graduate students do pursue studies or field research in Russia, the high school exchanges envisaged under the FSA have been exchanges mostly in name. The absence of genuine exchanges has clearly circumscribed the number of Russian participants.

This problem may not be amenable to a direct solution, but potentially there is a way to get around it. If the student exchange programs were redesigned so that American high school, undergraduate, and graduate students were treated as a single category, the pool of students who could be paired with Russian high school students would be much larger. The exchanges would not be strictly one for one, but they would be far closer to genuine exchanges than in the 1990s. The same principle could be adopted by Canada, Britain, Australia, Germany, and other Western countries for their own student exchanges with Russia. The aim would be to expand the annual number of Russian high school participants to the thousands originally envisaged.

If indeed some 15,000 to 20,000 Russian high school students a year were to attend school in the United States and thousands of others were enrolled in other Western countries, the benefits would be immense. The Russian students would receive a first-hand look at democratic procedures, civic initiatives, and a market economy. Upon returning to Russia, they could try to replicate in their own society what they had seen and experienced abroad. They also could encourage many of their fellow students to take part in exchanges and to seek greater exposure to the West. A massive expansion of the high school exchanges would be particularly valuable over the longer term, as the number of alumni of the program rose into the hundreds of thousands. Such a trend would give a much-needed boost to U.S.-Russian relations and would facilitate the introduction of democratic norms and capitalist institutions in Russia, providing an alternative for young people who might otherwise have gone to work in Russia's WMD facilities. Although student exchanges are certainly not a panacea, they seem to offer the best long-term option for coping with the human dimension of the strategic proliferation threat in Russia.

CHAPTER 6

APPENDIX

EFFORTS BY WESTERN GOVERNMENTS AND ORGANIZATIONS TO EMPLOY RUSSIAN WMD SPECIALISTS

This appendix is a supplement to the fourth section of my chapter. It explains why the programs established by Western governments and organizations over the past decade to employ Russian WMD experts in nonmilitary jobs cannot provide long-term alternative employment for more than a very small fraction of the total pool of WMD specialists in Russia. A fully documented version of this appendix is available from the author upon request.

Science Centers Program.

The International Science and Technology Center (ISTC) was established in Moscow in November 1992 by the United States, Japan, Russia, and the European Union (EU), with an initial commitment of \$75 million. A Ukrainian counterpart of the ISTC, the Science and Technology Center in Ukraine (STCU), was set up by the United States, Sweden, Canada, and Ukraine a year later. The main purpose of the two centers is to employ WMD scientists in “Science Projects” and “Partner” programs. The Science Projects are solicited directly by the ISTC and STCU, whereas the Partner projects are solicited by foreign businesses, scientific institutes, nongovernmental organizations (NGOs), and government agencies, working in coordination with the ISTC or STCU. Teams of scientists

from research institutes in the former Soviet Union (FSU) carry out the requisite work.

From 1992 through the end of 2000, a total of 590 science center projects involving 431 research institutes in the FSU received a total of \$329 million. The large bulk (more than 85 percent) of this money was provided by the ISTC, which approved another 141 projects in 2001 for an additional \$34.7 million. Roughly half of the funding for the two science centers has come from the United States (initially via the CTR program, and since 1995 mainly through the State Department), and most of the rest has been provided by the EU and Japan. The foreign businesses, laboratories, governments, and NGOs that fund the science center Partner projects are supposed to be able to send untaxed monetary contributions and duty-free shipments of capital equipment to researchers and their institutes in the FSU. In Russia, however, the nontaxable provisions have been difficult to enforce. Although the ISTC established individual bank accounts for grant recipients to prevent taxes from being assessed, the Russian government has levied taxes on ISTC capital purchases.

The science centers may provide a temporary diversion from WMD work, but their ability to create *long-term* alternative employment for Russian weapons experts is almost nil. The ISTC's Annual Report for 2000 claimed that 21,275 "scientists and their technical team members" in the FSU received payment for at least 1 day of work on ISTC projects in 2000, but the report also noted that the average number of days spent by team members on the projects was only 59. This figure is put into even starker perspective by a recent GAO report, which reveals that approximately half of the former Soviet scientists taking part in science center activities in 2000 spent a total of no more than a few days on their projects. Only about 3 percent of the participants devoted nearly all of their time to the projects, and even in those cases, the outside work ceased once the projects ended.

There is little reason to believe that the ISTC will be better able to secure permanent placements for Russian scientific workers over the next 10 to 15 years. Very few of the current ISTC projects appear sustainable over the longer term. One of the leading American experts on the program acknowledged in March 2001 that only five of the current projects—on synthetic neural networks, water quality monitoring, leak detection monitoring, titanium-nickel alloys, and early warning sensors for nuclear power plants—offer any hope of commercial success in the future. Not a single one of these projects, however, has yet been commercialized.

The ISTC program has been plagued by a number of other serious problems, especially the persistent indications that Russian scientists receiving ISTC support are continuing to pursue weapons research. The ISTC charter explicitly prohibits funding for defense-related projects, but, as the GAO recently noted, “the project agreements do *not* prohibit the scientists from continuing to work on research for their institutes including, in Russia, research related to nuclear weapons.” Even if the ISTC *did* try to ban all weapons research (something the Russian government would never accept), such a ban would be very difficult to enforce. As the GAO pointed out, the science centers “cannot track what the scientists are doing while they are not working on the projects or after the projects end. . . . [T]here is no formal way to monitor what other research these scientists are performing or for whom they are performing it.” In an earlier (1999) report, the GAO had presented disturbing evidence that many of the ISTC recipients were conducting weapons-related research when they were not working on the funded projects. There is little reason to believe that the situation has changed since then, particularly because so many of the Russian scientists spend so little time on the ISTC projects.

These considerations have spurred some analysts to warn that the ISTC cannot prevent foreign governments or terrorist groups from enlisting the aid of Russian weapons

scientists. The ISTC, they argue, is unable to halt the sharing of information over the Internet or “moonlighting by modem.” Moreover, rogue states could try to set up front businesses in Russia or Ukraine that would approach weapons scientists working on ISTC projects. Other concerns have been expressed about the misappropriation of funds from collaborative projects and the development of dual-use products under ISTC auspices that could later be incorporated into weapons programs.

To the extent that the ISTC projects are allowing Russian weapons scientists to spend only a limited amount of time on ISTC work while devoting most of their time to weapons research, the ISTC money can be seen, at least to some extent, as a subsidy for the Russian WMD complexes. There is even a risk, as the GAO acknowledges, that “financing certain [ISTC] projects could help sustain a weapons institute infrastructure in the former Soviet Union by keeping institutes in operation that might [otherwise] have curtailed their research functions for lack of funds.” If indeed the ISTC is inadvertently keeping some of the Russian WMD facilities in business, the negative consequences of the ISTC may outweigh any of the center’s gains.

Even if some of these problems can be remedied in the future, enough obstacles have emerged to cast doubt on the value of the ISTC in ensuring that former Soviet weapons scientists will be able to take permanent jobs outside the defense complex.

Initiatives for Proliferation Prevention (IPP).

The IPP, a program launched in 1994 (under a different name) by the U.S. Department of Energy, promotes partnerships between research institutes in the FSU and members of the U.S. Industry Coalition (USIC), an alliance of private American companies. Beginning in 2002, the IPP will be expanded to encompass the activities of the NCI, which is being merged with the IPP. From 1994 to 2001, the

IPP established a total of more than 400 projects at 171 research institutes in the FSU. Of these projects, roughly 85 percent were in Russia, though only about a quarter of them were in the nuclear closed cities. When the IPP started, 70 percent of its funding was earmarked for the employment of nuclear weapons scientists, and 30 percent was to be used for CBW researchers. In practice, however, well over 70 percent of funded projects have involved nuclear-related institutes, and most of these have been outside the ten closed cities. (In 2000, for example, 26 of the 29 newly approved projects involved nuclear-related facilities, whereas only three involved biological institutes.) Because the IPP recently changed its guidelines to stipulate that “reasonable [FSU] institute openness and access are a requirement of receiving funding,” it is unclear how feasible it will be in the future to set up projects in the closed nuclear cities or at the main CBW institutes.

For several years after 1994, the IPP was plagued by egregious administrative deficiencies, most of which have now been corrected. The deficiencies were highlighted in a February 1999 GAO report, which disclosed that relatively little of the money allocated to IPP projects had actually reached scientists in the FSU. The remainder of the funding—some 63 percent—had been spent in the United States on oversight and implementation costs. The GAO also discovered that the number of scientists receiving funds was sometimes unknown, and that IPP officials could not always confirm that the programs were targeting the institutes and researchers for which they were intended. In addition, the GAO found that a substantial number of Russian participants were using their IPP projects to pursue “dual-use technologies” that could be adapted later on for military purposes, and it revealed that some of the scientists at DOE laboratories who were responsible for overseeing IPP projects were unaware of the amount of funding their Russian counterparts had received. In at least one case cited by the GAO, not a single Russian scientist or engineer was employed at the institute that was being

funded. In another case, the Russian institute had failed to spend any of its IPP funding on scientists' salaries and had used the money instead for "overhead, travel, computers, and Internet access."

The public disclosure of these shortcomings (and the controversy that ensued) prompted major reforms. The head of the IPP was replaced, and important administrative safeguards were adopted. Beginning in 2000, at least 60-65 percent of IPP funding was supposed to be allocated directly to projects in Russia, rather than to administrative expenses in the United States. In addition, the IPP increased the stringency of the multi-stage review conducted by the Inter-Laboratory Board (ILAB, a body consisting of experts from ten DOE national laboratories and DOE's Kansas City plant) to ensure that new projects conform to the program's goals. In particular, the ILAB adopted stricter criteria to guard against the dual-use phenomenon. The IPP also established an accounting and auditing system to ensure that funds are transferred to the proper recipients and are used for the intended purposes. The focus of the program has shifted as well. Whereas the IPP originally envisioned a three-phase life cycle for most projects—a start-up period supported by government funding (Thrust 1), joint capital investment by government and private sources (Thrust 2), and full privatization (Thrust 3)—the program since 1999 has concentrated primarily on phases two and three. The IPP thus has implemented all of the recommendations proposed by the GAO in its 1999 report.

Significant though these improvements have been, the ability of the IPP to provide permanent nonmilitary employment for large numbers of Russian WMD experts is and will remain inadequate. As Siegfried Hecker, the long-time director of Los Alamos National Laboratory, recently observed, "The scale of the [IPP] has never been commensurate with the magnitude of the problem." Although the IPP in recent years has sought to promote commercialization efforts and cost-share partnerships with

private corporations, this effort as of late 2001 had yielded little by way of long-term employment opportunities—a mere eight projects that support only 294 permanent jobs, most of which are not filled by highly trained WMD experts. None of these eight ventures involves spinoffs of the major nuclear weapons institutes or CBW facilities. Although IPP officials claim that a few other cost-shared projects also “have good prospects of commercial success” in the years ahead, there is in fact relatively little that can be accomplished in the absence of sufficient capital investment from Russia’s private sector. The net commercialization results have been—and undoubtedly will continue to be—minuscule compared to the enormous number of Russian WMD experts who need to be absorbed.

The daunting scale of the problem would overshadow the IPP’s achievements under the best of circumstances, but the situation is made even worse by certain aspects of the program. According to official data, a total of 10,874 scientists and engineers from the FSU have taken part in IPP projects from 1994 through the start of 2002. However, many of these participants have never actually been involved with WMD programs. The IPP has no ironclad way—even with the help of U.S. intelligence agencies—to ensure that the right people are actually taking part in its projects. Under recent IPP guidelines, “new project proposals must list the [former Soviet] scientists and engineers, along with the nature of their involvement in weapons of mass destruction work during Soviet times.” But IPP officials have no independent means of corroborating this information. Although the IPP officially “expects that a preponderance of [Russian and FSU] staff involved in IPP-funded projects” will have worked at one time or another on WMD programs, the phrasing of this guideline contains two glaring loopholes: First, “expecting” something is not the same as “requiring” it. Second, there is no way to tell whether the IPP’s “expectation” has been met unless one assumes that the information provided by the Russian

institutes and Minatom is correct—an assumption that is dubious at best.

As for the Russian IPP participants who *have* been engaged in WMD work, the large majority have returned full-time to weapons research after their IPP projects were completed. Indeed, even when Russian WMD experts have been working part-time on IPP projects, they have continued to be actively involved with WMD programs. This arrangement is explicitly permitted under the IPP's General Program Guidance:

Given that IPP projects may not always employ Russian nuclear weapons scientists and engineers full time, it is possible that these specialists may work on nuclear weapons-related activities of the Russian Federation while not engaged on IPP projects. . . . Scientists and engineers still employed in Russian nuclear weapons facilities are not precluded from working on IPP-funded projects.

Whether such activities are compatible with the underlying purpose of the IPP is, however, far from clear. Doubts about the matter were expressed in late 2001 by the GAO, which, after noting that former Soviet weapons experts who are employed part-time on IPP projects “often continue to work at former Soviet WMD research institutes,” warned that “aiding such scientists . . . could create new risks for U.S. national security.” The GAO also emphasized that efforts to “assess the impact of [U.S.] aid” on the Russian WMD complexes have been stymied by “Russia’s reluctance to provide U.S. officials with full access to relevant sites and materials.” Thus, even if the dimensions of the problem were not so overwhelming, the IPP may inadvertently be making things worse by subsidizing experts who continue to work on WMD programs.

On balance, then, despite notable improvements in the IPP since 1999, its role in countering the threat of strategic proliferation is questionable. The IPP may prove more effective than the Science Centers program (which is

limited to grant-making), but there is no reason to believe that the IPP can foster permanent alternative jobs for tens of thousands of Russian WMD experts over the next 10 to 15 years. The magnitude of the problem is too vast, no matter how well the IPP is run.

Nuclear Cities Initiative (NCI).

The NCI, another program run by DOE, was founded in September 1998 as a Russian-American partnership. Beginning in 2002, the NCI will be folded into the IPP. As the name implies, the NCI was supposed to “assist the Russian Federation in its announced intention of reducing the size of its nuclear weapons complex” and to “promote nonproliferation goals through redirecting the work of nuclear weapons scientists, engineers, and technicians in the Russian closed nuclear cities.” Together with officials from Minatom, the NCI developed five strategies to achieve these goals: the development of city-by-city plans for downsizing; the development of local infrastructure; the facilitation of the transition from weapons research to commercial research; training and other community resource development activities; and the leveraging of funds and general encouragement of investment.

During the 4 years of its existence, the NCI established several projects each in Sarov, Snezhinsk, and Zheleznogorsk, the three closed nuclear cities that were initially targeted. Two International Development Centers, two Open Computing Centers, and two Nonproliferation Centers were set up, and some very limited commercial ventures were initiated or expanded. In total, however, only 100 new jobs were created for Russian scientists and engineers, a result that even supporters of the NCI described as “paltry.” Part of the problem was that only 30 percent of the \$16 million allocated to the NCI during its first few years was actually spent in Russia. The rest went toward administrative and other costs in the United States. Even if the funding had been several times greater and more

of it had been spent in Russia, it is not at all clear that the NCI would have fared any better. A number of circumstances inherently limited the value of the initiative.

First, DOE and the U.S. nuclear laboratories were not—and are not—well suited to promote commercial development, particularly among Russian weapons scientists who lack any tradition of entrepreneurialism. A recent analysis of the IPP showed that U.S. Government funding had not gone toward projects that respond to “the technology innovation needs of Western industry.” DOE’s handling of the NCI was even more dismal. A GAO report on the program in mid-2001 highlighted DOE’s inability to promote commercial activity in the closed cities, citing, among other examples, the undue emphasis given to community development:

DOE officials told us that community development activities are needed to help make the cities more attractive to potential Western investors. However, none of the [private] industry officials whom we talked to during the course of our audit indicated that they would be more likely to invest in the nuclear cities because of municipal and social improvements.

The GAO report also noted that “the most successful commercial effort we observed in the nuclear cities” involving former weapons scientists was a computer venture in Sarov that was “undertaken *without* U.S. Government assistance.”

Second, the Russian government’s priorities for the NCI were never really conducive to U.S. nonproliferation goals. In particular, the Russian authorities prevented the NCI from extending to facilities that were of genuine proliferation concern. Siegfried Hecker, the former director of Los Alamos, recently acknowledged that the NCI “was handicapped from the beginning” because “the Russian government insisted, and the U.S. Government agreed, to restrict [the NCI’s] activities only to the “‘open’ parts of the closed cities,” meaning the portions outside the fences of the nuclear weapons institutes. Conflicts over this matter, and

the two sides' diverging views of the best projects to pursue, spawned what Hecker described as "an atmosphere of increasing hostility and mistrust between the Russian and U.S. Governments" from 1998 on.

Third, even after the key WMD facilities were excluded from the program at Moscow's insistence, the Russian government prevented NCI officials and potential foreign investors from gaining adequate access to other parts of the closed cities. The Russian authorities kept the number of visits to a minimum, required long lead-times (at least 45 days and sometimes several months) for approval of visits, limited the size of the visits to no more than a few people, and prohibited any access to a large number of facilities. Many requests for visits were simply turned down. The result was that NCI personnel were unable to maintain adequate supervision over projects, and prospective investors were deterred from even considering most ventures.

Fourth, even if the NCI projects had been impeccably designed and structured, there were many barriers in the closed nuclear cities—and in Russia as a whole—to commercial success (beyond the uncertainty about access just described). The geographic and economic remoteness of most of the cities was itself a major obstacle to development. To be viable over the longer term, the projects eventually would have had to receive sizable loans from Russian banks or direct foreign investment. Yet, even now, despite recent improvements in the Russian economy, almost nothing has been done in Russia to transform the banking sector into a viable institution that will function as banking systems do in the West. In the absence of key features of a market economy—a sound financial infrastructure, solid guarantees of property rights, and reliable means of enforcing contracts—foreign investors would have been extremely reluctant to commit funds to Russian-based ventures, even if physical access to the sites could have been assured. Hence, NCI projects were bound to encounter the

same sorts of problems that bedeviled the commercialization efforts of the IPP.

Thus, there is no reason to believe that the merger of the NCI with the IPP will increase the IPP's ability to provide permanent alternative employment for many thousands of Russian WMD scientists and engineers. At best, the NCI amounted to what the GAO described as "a subsidy program for Russia . . . rather than a stimulus for economic development." At worst, the NCI may actually have helped keep the Russian nuclear weapons complex larger than it should be. Russian officials acknowledged in 2001 that "most of the scientists receiving [NCI] funds continue to work on Russia's weapons of mass destruction programs." Oles Lomacky, the executive director of the ISTC from 1995 until 1997, warned that it was a "fantasy" to believe that "if you give Russian scientists enough money, they will stop doing what they were doing before, which was designing weapons. . . . [T]he same people who were designing bombs in the Soviet era are still there." Lomacky added that "our objective ought not to be maintaining the nuclear cities" through the NCI; instead, the United States should promote "opportunities for these [bomb designers] to do other things somewhere else."

Although only some of the NCI's activities will be continued under the auspices of the IPP (the other activities will simply be terminated), it is conceivable that the merger will be a net detriment for the IPP. The risk of the NCI all along, as a U.S. Congressional Budget official warned in 1999, was that it would simply "create expectations of long-term assistance and thereby reduce any incentives for [Russian nuclear scientists] to find work in the commercial sector," leaving the United States in the position of supporting "Russian scientists and engineers who continue to design and build nuclear weapons." That is clearly something that IPP officials will want to avoid.

Even if the merger can be handled smoothly, the only question for the purposes of this chapter is whether the

transfer of NCI activities to the IPP will significantly increase the likelihood that the IPP can generate permanent, non-military jobs for the 60,000 or so highly-trained WMD scientists, engineers, and technicians who are of greatest proliferation concern. There is no basis for concluding that this will be the case.

Nongovernmental Efforts.

The Civilian Research and Development Foundation (CRDF), a semi-private American venture set up by the U.S. Government in 1995, is supposed to arrange collaborative research projects between scientists in the United States and the former Soviet Union. One of the major aims of the CRDF is to fund civilian R&D projects that will help weapons scientists in Russia's closed cities leave the defense sector and focus on civilian pursuits. To date, however, the organization's accomplishments have been negligible. The CRDF Closed Cities Program funded 19 projects in Sarov and Snezhinsk from 1996 to 2000, but the amount of investment (\$275,000) was too small to create any permanent new jobs. Moreover, none of the ventures proved commercially viable.

Most of the other U.S. and West European non-profit foundations that have supported Russian science have dealt exclusively with the civilian institutes. In the early 1990s, foreign foundations provided an extremely important boost to scientific research in Russia. The MacArthur Foundation, the Fulbright program, and the Carnegie Corporation launched pioneering efforts, and other American foundations soon followed suit. In 1993 the Russian Academy of Sciences received more funding from the International Science Foundation (ISF, an organization established in late 1992 by the American billionaire George Soros) than from the Russian government. During the 4 years of the ISF's existence, from 1993 through 1996, the foundation provided roughly \$130 million for scientific research in the former Soviet Union. As late as 1995, up to

one-third of all money for civilian science in Russia and Ukraine was still coming from foreign organizations and foundations, including the ISF. Professional scientific societies in the United States, including the American Astronomical Society, the American Physical Society, and the American Mathematical Society, launched separate fund-raising efforts in the early 1990s for their Russian counterparts and transferred tens of thousands of scientific periodicals and books free of charge to Russian scientists and research institutes.

Similar efforts were made in Western Europe (especially Germany) by professional organizations and non-profit foundations such as the Friedrich Ebert Stiftung, the Volkswagen Stiftung, and the Konrad Adenauer Stiftung. In May 1993 the European Union established the International Association for the Promotion of Cooperation with Scientists from the New Independent States of the Former Soviet Union (INTAS). With an initial annual budget of \$27 million and a mandate to “promote cooperation with scientists” from the former Soviet Union until at least the end of 2002, INTAS was able to support a wide range of activities throughout the 1990s.

Since 1995, the level of foreign foundation support for scientific activities in Russia has declined, but funding from abroad (including money from Western private companies) remains crucial for scientific research in Russia. As of 1999, some 16.9 percent of gross expenditures on R&D in Russia came from foreign sources, well above the level of just a few years earlier. Although Western foundations have shifted most of their emphasis from individual grants (which were heavily funded in the early 1990s) to basic support for research institutes and science education, a number of key grant programs are still operating. Foreign funding is likely to remain extremely important even though the future of some activities (especially the International Soros Science Education Project, a successor to the ISF) was temporarily thrown into doubt in 2001 when the second part of Russia’s new tax code took effect. Under the guidelines

accompanying the code, a 35.9 percent “social tax” was to be imposed on individual grants. The Soros Foundation had to go through a lengthy appeal process to secure an exemption from the tax, which otherwise would have placed a crippling burden on the science education project.

Even though important grant-making programs for Russian scientists are likely to continue under foreign auspices, and even though a number of closely related activities have been set up, including a program launched by the MacArthur Foundation in 1997 to fund basic research and higher education in Russia (a program subsequently funded as well by the Carnegie Corporation of New York and overseen by the CRDF), these projects have no direct bearing on scientists, engineers, and technicians in the Russian defense complex. Indirectly, a few of the programs may offer a fallback option—albeit only a limited and transitory one—for some of the scientists and engineers who might choose (or be forced) to leave the weapons complex, but the total amount of funding available is much too small to accommodate more than a handful of them over the long term.

Initiatives by American aerospace corporations to collaborate with Russian enterprises could provide an alternative source of employment for a small number of weapons scientists (though not necessarily those working on WMD programs). The Boeing Corporation established a research center in Moscow in 1993 and now employs 500 workers in seven Russian cities. The company recently signed an agreement with the Russian Aerospace Agency to collaborate on space research, rocket launch technologies, and the development of a short-range jetliner. Lockheed Martin has undertaken joint research and development projects with other Russian enterprises such as the Vavilov Institute, the Skobeltsin Nuclear Physics Institute, the Ioffe Physics-and-Technology Institute, Khrunichev Industries, and the Yakovlev Central Design Bureau. The collective impact of private sector collaborations such as these on the employment of former weapons scientists (exclusive of the

activities of members of the U.S. Industry Coalition and other corporate participants in U.S. Government programs) is unclear, but at best their role in providing new jobs for WMD experts will be minor.

CHAPTER 7

DEFENSE CONVERSION: HOW FAR CAN RUSSIA EXPAND SMALL AND MEDIUM ENTERPRISES?

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While numerous barriers have hampered the growth of the small and medium enterprise (SME) sector in Russia, this sector has the potential to help curb proliferation of strategic weapons and technology from Russia. The long-term development of a more significant SME sector in Russia would help provide alternative employment opportunities, reduce excess military-oriented research and development (R&D) capacity, increase nonweapon export revenues, and encourage broader economic reforms and nondefense enterprise growth. These potential contributions are particularly important, given the continuing Russian government focus on large defense enterprises, the weak record of new job creation in Russia, and the failure of defense industry conversion efforts. This chapter considers the major barriers to SME growth, examines factors supporting such growth, and offers a range of suggestions for how Western policies can help the Russian SME sector develop so as to play a positive role in reducing strategic weapons proliferation from Russia. In the U.S. approach to such barriers, of course, care must be taken to avoid dismantling those that, while discouraging Russian SME growth, also discourage proliferation activities.

After a period of rapid growth in the early 1990s, the Russian SME sector has stalled and is less than one-fifth the size of comparable SME sectors in other advanced economies. The most powerful barriers include:

- Institutional and administrative burdens (excessive tax, bureaucratic corruption, regulatory burdens, lack of effective government support or unemployment safety net);
- Resource and demand constraints (inadequate access to start-up capital or other financing, low investment, barriers to market entry that favor large incumbent businesses, depressed domestic demand, unequal market competition);
- Personal and societal views (negative views of entrepreneurs, resentment, risk-averse technologists, passivity, preference for large-scale/high-end projects, fear of uncertainty);
- Managerial approaches (focus on old bureaucratic methods, focus on state support, lack of effective new ownership, low turnover, lack of skills to identify markets); and,
- Structure of defense R&D in Russia (labor-intensive, lack of integration, state support and hidden subsidies for large enterprises, lagging technology development, lack of marketability).

Nevertheless, there are some positive factors that may be exploited to promote SME sector growth, particularly in market niches such as information technology, offshore programming services, medical equipment, and consulting where there is access to foreign markets and funding.

There are lessons from past cases and experiences in other transition economies to help guide Western policies and assistance programs in more effectively encouraging the emergence of a larger Russian SME sector, thus helping discourage proliferation:

- Emphasize market-driven commercialization and focused business services; recognize that many market areas tend to be medium-tech instead of high-tech, and that the early involvement of Western private sector partners can be critical;
- Establish clear program goals and evaluation guidelines; avoid projects and enterprises that do not meet initial viability criteria;
- Focus support on local and regional programs that have proven most effective (a number of regions in Russia have demonstrated effective SME growth using local programs); and,
- Reduce the emphasis on short-term assistance to employees at incumbent or state enterprises (encouraging personnel to leave those incumbent enterprises will be critical in achieving long-term SME sector growth and reducing excessive focus on continuing military work).

Introduction.

This chapter investigates how efforts to encourage entrepreneurial activity in Russia's defense scientific and production sector could serve as part of a long-term strategy to reduce the proliferation of strategic weapons and technology from Russia. In particular, I look at the potential for expanding the SME sector in Russia, and consider the impacts this may have on Russian proliferation behavior. While entrepreneurial activity is broader than the SME sector, the growth and status of SMEs are critical indicators of the activities of entrepreneurs in creating new jobs and innovative technology in many transition and advanced economies, and can serve as a good measure of the scale of entrepreneurial activities in the Russian economy.

The proliferation of strategic weapons and technology from Russia is driven by many factors that are not affected by the SME sector, but growth in the SME sector can have

significant impacts on both the capabilities and the incentives for individuals and enterprises to proliferate weapons and technology.¹ Given the strong Russian government focus on large enterprises as the core of Russian defense industry, as well as the weak job creation in the Russian economy and the failure of efforts to convert or restructure Russia's defense industry towards civilian applications, it would appear that an expansion of the SME sector may help reduce Russian proliferation by the following means:²

- Providing alternative employment opportunities for defense sector technical specialists and other personnel;
- Reducing excess military-oriented industrial and scientific capabilities;
- Increasing Russia's ability to earn revenues through activities other than exporting raw materials or military capabilities;
- Encouraging stronger economic reforms and enterprise growth in areas not related to the military; and,
- Reducing the influence of the defense sector in government policymaking.

However, it is important to recognize that some types of expanded SME activities may dismantle existing barriers to proliferation and brain drain, thus harming nonproliferation efforts.

While the small business sector has been a significant source of innovation and new job creation in many successful transition and advanced economies, this sector is simply too small to play a comparable role in Russia unless major steps are taken to expand it. The Russian SME sector remains much smaller than those in many other transition economies or Western countries. For example, the share of gross domestic product (GDP) produced by the SME sector is 5-6 times larger in mature

market economies than in Russia.³ The successful transition economies of Poland, Hungary, and the Czech Republic also have much more significant SME sectors than Russia, with over one million SMEs in Poland, and 500-700 thousand in Hungary and the Czech Republic. The relatively small size of the Russian SME sector is shown in Table 1 (based on 1997 data). In addition to being undersized, the Russian SME sector is very geographically concentrated. About a third of all Russian SMEs are located in just Moscow and St. Petersburg alone.

Country	Number of SMEs (thousands)	Number of SMEs per 1,000 Population	Employment by SMEs (millions)	Percentage of Total Employment	SME Share of GDP (Percentage)
Japan	6,450	49.6	39.5	78	52-55
EU	15,770	45	68	72	63-67
U.S.	19,300	74.2	70.2	54	50-52
Russia	844	3.6 - 5.7	8.3	13	10-11

Table 1. Relative Size of SME Sectors.⁴

The SME sector did not exist at all in the Soviet period. All enterprises were entirely state-owned, and the concept of private business was not accepted until the economic and legal reforms of the late 1980s.⁵ While the SME sector in Russia grew rapidly after private enterprises were legalized in 1990-91, growth of this sector stalled in Russia after 1994, with the decline in the number of people employed by small firms reflecting a worsening climate for such firms.⁶ In fact, the number of small businesses in Russia that specialize in R&D reportedly fell by 60 percent in the period 1994-97. The proportion of small businesses specializing in R&D fell from 8.2 percent of all SME in 1994, to 5.1 percent in 1997.⁷ While trade and service sectors in Russia have seen the emergence of widespread SME activity, small businesses have not played a significant role in the R&D, technology-intensive, or defense-related areas.

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Number of Firms (thousands)	268	550	875	896	877	842	861	868	890
Number of Full-time Employees (thousands)				8,480	8,995	6,269	6,515	6,208	6,292
Number of Part-time Employees (thousands)				6,677	4,926	2,352	2,124	1,194	970

Table 2. Russian SME Sector Employment, 1991-98.⁸

BARRIERS TO ENTREPRENEURIAL ACTIVITY IN THE DEFENSE SECTOR

An enormous number of barriers have limited the growth of entrepreneurial activity and the SME sector in Russia, and many of these limiting forces are particularly strong in defense-related sectors. These factors have contributed to the current situation where large businesses and institutes continue to dominate the defense sector, while the existing SME sector remains too small to play a significant role in creating new jobs. In fact, many conditions for SMEs worsened during the 1990s, and continue to be problematic today.

Institutional and Administrative Constraints.

Factors such as excessive tax, bureaucratic corruption, regulatory burdens, lack of government programs to promote SMEs, lack of adequate intellectual property rights (IPR) protection, and lack of an effective unemployment safety net have severely hampered the development of entrepreneurial activities and the SME sector in Russia.⁹ These factors have combined to distort the emerging Russian market and hinder the emergence of entrepreneurial small business. There are literally hundreds of state bodies involved in oversight and regulation of SMEs at all levels of the economy.¹⁰ For

example, inadequate protection of IPRs has led to a situation where an estimated 90 percent of the software applications used in Russia are pirated (vs. under 30 percent in the United States), thereby significantly limiting the ability of the new software industry to develop profitable domestic markets in Russia.¹¹ The fact that Russian state institutions often have partial patent rights over the work of their personnel further complicates the IPR situation for prospective private enterprises.

The tax system disadvantages small firms due to the onerous compliance burden (maintaining records, declarations, dealing with multiple tax organizations) and excessive rates. Administrative barriers include the numerous registration, licensing, and reporting procedures imposed on small businesses by multiple levels of authorities and administrative bodies. The need to obtain licenses and administrative permissions from numerous bureaucratic offices provides fertile ground for corruption. In addition, surveys report that 75-80 percent of SME managers complain of being subjected to threats and coercion from criminal groups. Many large enterprises continue to play significant welfare support roles, meaning that the large ministries, scientific research institutes, and producers have an advantage over smaller enterprises in providing social benefits such as housing, access to health care facilities, etc.¹²

Russian government support programs and IPR protections for SMEs are ineffective. While many Russian and international studies have pointed to the problems caused by the numerous administrative barriers to SMEs and while many Russian government programs and regulations have declared support for dismantling these barriers, it appears that these problems have, in fact, worsened during the past decade. There is a widespread perception that while some tax incentives for SMEs were instituted in 1990-95, the Russian central and regional governments have not taken enough action to build a support framework or provide funding sources for small

businesses or R&D activities since the mid-1990s. As happens all too often in Russia, the laws passed in support of SMEs have not been implemented, and many government initiatives have not been adequately funded.

In addition, Western assistance programs that seek to address proliferation concerns have primarily focused on large state organizations, thus encouraging scientists and specialists to retain their ties with these organizations. Many of the plans being developed to revive the Russian R&D sector or overall economy itself still focus on the largest enterprises and top-down approaches. The Russian government and many industry analysts have discussed converting the military-industrial complex into a scientific-industrial complex, but they still focus on doing this by reviving the largest enterprises and funding new large conglomerates, not by focusing on the needs of SMEs.¹³

Resource Constraints.

The inability to access sufficient financial resources to support and expand new businesses has hampered the Russian SME sector. These barriers include insufficient banking and financing sources, low levels of investment, and the practice of banks providing funds based on personal connections or a preference for funding export operations.¹⁴ The poor investment climate in Russia has discouraged foreign direct investment (FDI), which has been valued at under 1 percent of Russian GDP, compared to over 7 percent in Poland and even higher in other advancing economies.

Even Western programs to provide loans have not focused on technology start-ups, and often disburse most of their funds to businesses in the service and retail trading sector. For example, U.S. funding provided to the European Bank for Reconstruction and Development's Russia Small Business Fund (as part of the U.S. Nuclear Cities Initiative) has been disbursed largely to the trading sector, where most loan recipients do not have employees linked to scientists.¹⁵

The domestic Russian banking sector is not well developed and has been reluctant to invest in the military sector outside the largest export-supported enterprises. Thus, SMEs lack access to adequate start-up capital, and are often forced instead to rely on personal resources, family, friends, and criminal structures.

Demand Constraints.

Many Russian SMEs have a hard time finding markets for their goods and services because they face dominating state and large businesses, foreign competition in higher-technology areas, and overall depressed domestic demand.¹⁶ SMEs face significant barriers to entry in many market areas due to hidden subsidies, administrative measures, and distorted prices that all favor large existing businesses. Russia still has far to go to develop a competitive market economy, and there are distortions in much economic activity that limit the ability of entrepreneurs and SMEs to find domestic markets. In addition to the depressed demand, the lack of information about market demand has led to waves of excess competition as multiple enterprises seek to produce similar products, ignorant of the others' activities.¹⁷

Barriers to entry created by numerous hidden subsidies, administrative measures, and distorted prices that still support large state-owned, or former state enterprises, make it difficult to start up new private firms even if they are more productive than the existing firms.¹⁸ Market distortions that stem from efforts to address social concerns, corrupt practices, and the lack of information continue to raise barriers to SME and prevent equal competition. A 1999 McKinsey report argues that the unequal market competition conditions "tend to favor low productivity incumbents, protecting them from takeovers and productive new entrants."¹⁹

Personal and Societal Views.

There are deep-seated personal views and beliefs pervasive in Russian society that have limited the growth of entrepreneurial activity and SME business activities, particularly in the defense-related sector. At the personal level, many scientists and defense technologists who could start up SMEs tend to be risk-averse, older, and ill-adapted as entrepreneurs.²⁰ These potential entrepreneurs often display such attributes as passivity, a reluctance to stand out from the herd, fear of job instability in new small companies, and a preference for more “interesting” high-tech R&D instead of commercial projects. The history of failure when individuals in the military-industrial or R&D sector seek to start new enterprises without having high-level connections has also added to personal reluctance to leave the relative stability of large or state-funded organizations to undertake new entrepreneurial ventures. Even some entrepreneurs, who have set up relatively well-paid teams of Russian computer programmers to provide outsourcing support for U.S. and other Western companies, report that they have difficulty finding Russian programmers who want to work on these projects because they view them as less interesting and less challenging work than their military-related or scientific work.²¹ In addition, many would-be entrepreneurs have a pronounced preference for large projects, often seeking to start with expensive large-scale projects instead of the smaller, incremental approach favored in the West.²²

At the societal level, public opinion polls reflect an uncertain and ambivalent attitude towards “entrepreneurs,” who are often seen as shady and dishonest, and sometimes resented for their apparent wealth. Surveys report common resentment of private wealth and private business, and negative attitudes towards entrepreneurs and spin-offs from state organizations.²³

While the passivity of many Russians in terms of accepting the conditions within which they live and not

acting to take control to change those conditions may hamper the development of entrepreneurial activities, such passivity can also serve to restrict some types of proliferation activity. For example, surveys of specialists working in key Russian nuclear and missile facilities in some of Russia's closed cities have found that a basic passivity has helped keep these specialists from acting to go abroad or sell their skills to foreign customers.²⁴

Managerial Approaches.

Many managers in the military-industrial sector have been conditioned to be risk-averse, conservative, focused on maintaining large payrolls, and wed to using old methods, cronyism, and appeals for state support instead of restructuring their enterprises or moving away from reliance on government orders. Privatization of industry has not led to effective control by new owners who would promote market-oriented entrepreneurial approaches, and the defense R&D sector is much less privatized than the production sector.²⁵ Instead, enterprise managers have gained increased power to push for state support, but have not become accountable to profit-driven imperatives or outside owners. There has been low turnover in management. By one estimate, as little as a 5 percent change per year has occurred in enterprise management.²⁶

Military-industry managers have been conditioned to be risk-averse, conservative, and tolerant of bloated payrolls. They are skilled at bureaucratic infighting, and most are not inclined to be entrepreneurs. These traits persist today for many managers.²⁷ Their tendency has been to build bigger groups (financial-industrial groups, holdings, etc.) rather than to fully pursue independent spin-offs or SMEs. The partial shift in ownership at many enterprises has not led to effective new ownership control, and has allowed the legacy directors to assume greater control in many cases. This has contributed to their becoming less responsive to the state, pursuing instead their own parochial interests. In

addition, many managers continue to believe that state defense orders will revive, so they hold out for the benefits from that eventuality. Recent funding increases under the Putin administration, increased funding from Minatom for nuclear weapons enterprises, and the promises of more to come have worsened this problem. Managers often see commercial work as temporary, and seek short-term projects to help tide them over until government funds arrive.²⁸

Most managers lack the skills and ability to identify market opportunities. For example, the RAN USA and Canada Institute operated several programs with Pepperdine University in the United States to provide business training to over 100 managers from large Russian military-industrial enterprises, but the business plans those managers developed after receiving training were not implemented because they did not identify viable areas of demand in the Russian market.²⁹

The defense sector managers are gradually being forced to change their approaches as their environment changes. By the late 1990s, it became apparent from periodic observer visits to Russian military R&D and production facilities that those organizations doing relatively well tend to have the most dynamic and assertive directors, in addition to having access to foreign markets for their goods.³⁰ The organizations whose directors or senior staff are still focused on the Russian government for support and guidance tend to be doing much poorer, but have still managed to survive, often as shells to provide some basic support for their personnel. Nevertheless, government support policies through the mid-to-late 1990s, for example, providing credits to help military-industrial enterprises in the worst shape, encouraged a continuation of sluggish managerial behavior. Whereas managerial behavior bent upon exploiting the old system worked relatively well in the early 1990s, it appears that the macroeconomic situation and market then became “more rewarding to qualified enterprise management” such that the quality of

management has now become more important in supporting enterprise success than it was earlier.³¹

Structure of Defense R&D Sector.

Despite hopes that the massive Soviet defense R&D sector would serve as a powerful source of innovation and technology capabilities to power a new high-tech industrial sector in Russia, efforts to convert this sector have largely failed. Overall, the Russian defense R&D sector has lost much of its technological competitiveness, as the lack of funding for R&D over the past decade, in addition to the relative inactivity of high-tech companies and SMEs, has taken its toll.

The R&D sector suffers from many of the same problems as those afflicting overall military industry, and faces many of the Soviet legacies such as excessive size, labor-intensive approach to research, extreme centralization, and geographic concentration.³² The defense R&D sector accounted for 70-80 percent of all Scientific Research Institute (NII) and R&D work, covering about one million personnel working in the science-related area at the start of the 1990s.³³ The Soviet approach led to separation of research, development, and production in separate organizational entities (NII, Design Bureaus [KB], Scientific Associations [NPO], Production Associations [PO]), and the breakdown of strict centralized Soviet controls has made this lack of integrated R&D chains particularly troublesome. While production associations and enterprises had a high degree of vertical integration in terms of production inputs, the clear separation of research facilities from the production sphere has hampered the sector's ability to move new innovations to the production stage. Moreover, it is very difficult to get a good picture of innovation in the defense R&D sector because official statistics leave many issues untouched. Much of the innovative activity has occurred in the unofficial areas of the economy.³⁴

The Russian military-industrial sector continues to be dominated by large enterprises, and small businesses have played a negligible role in defense research, design, development, and production. Indeed, the Russian military-industrial sector retains many of the characteristics that encouraged large enterprises, e.g., the advantage of size in giving enterprises influence, pressure for self-sufficiency in material inputs.³⁵ The Soviet-era orientation towards very large enterprises continues in the military-related scientific-research community, the production community, and others. A 1997 study found that large defense sector enterprises employing over 5,000 people performed better and were more successful in retaining their core capabilities than smaller firms.³⁶ More recent studies of the situation after the 1998 crisis found that mid-sized companies (500 to 2,000 employees) did well, but that small enterprises did worse in both surveys.³⁷ Directors of R&D organizations found that their position in the system was improved as their organizations grew solely in terms of numbers of employees or size of budgets, while profit margins were not even known, let alone considered. The artificial pricing system used through the early 1990s and the continuing system of hidden state subsidies have hindered the ability of the military-industrial sector to adjust in the transition to a market economy by making it almost impossible to calculate market values for inputs or products in much of the sector.

Many analysts argue that Russian fundamental research is of high quality, but that Russian capabilities are weak in applied R&D oriented towards creating civilian products with commercial potential. Most Russian technology is not internationally competitive, and Russia has a history of conducting R&D with little attention to cost or marketability considerations.

Russian technical experts do not have experience in market-driven R&D. Indeed, the vast majority of R&D personnel today still seek to sell technology-push capabilities-driven projects, instead of market-pull projects.

They market and propose what they know and have, but these capabilities are usually not what the commercial market wants. Almost any U.S. businessman today who visits Russian R&D facilities will come back with huge numbers of proposals regarding which scientists seek to find funding for their pet projects, regardless of the fact that no market demand conceivably exists.³⁸ It still remains to be seen how much commercial potential Russian defense technologies have, so Western-supported programs that focus on the commercialization of Russian lab technologies are taking a partial, ultra-cautious approach. This is not the path to a large-scale solution to the problem and is bound to provide only limited results.

In addition, there is a clear Russian government orientation towards large enterprises in the defense sector, with the Russian government giving preference in domestic arms contracts to large Russian firms that sell their weapons systems abroad because it views this ability to sell weapons on the global market as a key indicator of the firms' economic viability.³⁹ The Putin administration has placed increased emphasis on expanding arms sales as a critical source of revenues to fund military R&D programs, as well as fill state coffers and fund military-industrial enterprises themselves.⁴⁰ Current Russian government plans to restructure the defense sector call for merging many enterprises to create 30-40 even larger holding companies that will further expand industrial conglomerates that dominate defense industry.⁴¹

Security Restrictions.

Restrictive security regulations and pressures on employees who have worked in secure military-industrial facilities hinder the ability of these employees to create new SMEs. Access to international donors, technical exchanges, and travel abroad can all be restricted by the security organs. These restrictions have become stronger in the recent past, with a resurgence of FSB campaigns against

interactions with foreigners—including accusations that joint ventures are Western espionage efforts, and new Russian Academy of Science instructions requiring scientists with access to classified materials to report all contacts with foreign colleagues to the security departments. Even specialists who are no longer employed at military-related facilities have reported being subject to visits from security personnel who seek information and even press for bribes in exchange for noninterference in prospective new business ventures.⁴² As with many administrative barriers in Russia, the existence of security regulations often simply serves as a means for bureaucratic officials to extort additional payments from those complying with the regulation.

FACTORS PROMOTING ENTREPRENEURIAL ACTIVITIES

While numerous powerful forces have limited SME and entrepreneurial activities in Russia, the list of factors that encourage such activity is much shorter.

Economic Need.

The basic failure of the government to provide for the economic needs of most military-industrial enterprises has encouraged specialists to look elsewhere for work, and has begun to encourage the enterprises themselves to restructure and undertake more entrepreneurial activities. While a centralized large-scale approach to planning economic programs still dominates in many organizations, the absolute decline in conditions in much of the military-industrial sector serves to promote new approaches, if only out of desperation. It is estimated that the number of employees in military-related R&D organizations, e.g., NII, had fallen by 60-70 percent by the end of the 1990s, and many specialized design teams had fallen apart.⁴³ In 1992-94 alone, during the first wave of employee departures, overall employment in science fell

over 20 percent.⁴⁴ Numerous Russian defense R&D organizations have been hollowed out because many of the most capable, younger, active employees have gone, leaving behind the bureaucratic shells with too many managers and older staff who are often the least entrepreneurial.⁴⁵ The average age of workers in the military-industrial sector has risen from 47 years in 1996 to 58 years in 2000.⁴⁶

The lack of government funding, investment, or market profits for the defense sector can encourage new approaches. Total R&D expenditures fell over tenfold in the 1990s, and the share of military R&D in official Russian defense expenditures fell from 18.6 percent in 1990 to 3-4 percent in the late 1990s.⁴⁷ This decline in R&D has occurred in the context of the collapse in military output of the Russian defense complex without any corresponding increase in civilian output from the defense complex (see Table 3).⁴⁸

	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Total output	80.4	64.6	39.2	31.2	22.7	19.0	17.6	24.6	31.7
Military output	49.5	32.5	19.9- 26.8	16.6- 21.4	12.8- 17.2	8.8- 13.2	9.9- 13.9	13.9- 19	17.9
Civilian output	99.5	85.6	52.6- 46.4	41.3- 40.4	29.1- 33.5	27.8- 32.8	22.6- 30.2	39	

* - projected.

Table 3. Relative Military and Civilian Outputs of the Russian Military-Industrial Sector (1991=100).

In part due to the lack of centralized funding and failure of large-scale conversion efforts, many military-industrial enterprises allowed for the creation of internal spin-offs, and some of these have gone on to become viable SMEs working in technology areas. While there was a lot of activity in the early-to-mid 1990s, most enterprise efforts to produce more technology-intensive industrial and consumer goods were not successful—these markets were

dominated by imported goods.⁴⁹ The slight increases in overall output of the military-industrial sector in 1999 (Table 3) came as the demand for domestic consumer durables such as refrigerators, washing machines, and televisions rose, and as the foreign competition was priced out of the low-end market in the aftermath of the August 1998 crisis.⁵⁰

While insufficient central funding has encouraged many military-industrial enterprises to seek new approaches, the economic need has been sharpest in sectors of low proliferation concern, such as those producing many basic conventional weapons like tanks, rifles, etc. The industrial sectors of most concern to the West in terms of proliferation potential—the nuclear and missile industries—have been relatively well funded, and are increasingly better funded today.

Work Force Characteristics.

The Russian population is highly educated and technologically innovative. Universities and institutes in Russia have been producing highly skilled engineers, scientists, and other R&D specialists for decades. The numbers and percentages of young people enrolled in technical education fields continue to be among the highest in the world.⁵¹ The early boom in the expansion of the SME sector showed the existence of an entrepreneurial spirit in many Russians, despite the historical record of a state-dominated society, as the flow of active, entrepreneurial-minded specialists out of the defense sector provided critical skills to the new economy. Many of the initial SME managers in the early 1990s were technical specialists from the R&D sector, and they have paved the way for others to potentially follow.

Nevertheless, younger specialists are not entering the defense field, and admissions at most military-technical institutes have fallen. Banking and trade have been two of the leading sectors attracting talented young specialists

away from their training at prestigious technical institutes. Young people are not pursuing educational programs that would lead them into the defense R&D or industrial sector. By the mid-1990s, senior officials at prestigious military-technical institutes, R&D associations, and production facilities echoed the common refrain that the “Nike effect” was draining their organizations as the brightest youngsters left to seek their fortunes in the new economy, buying and selling sneakers or other imported consumer goods.⁵² Throughout the 1990s, increasing numbers of students at some of the most prestigious institutes, e.g., Bauman, either were leaving their studies early to go work in other areas or were applying their skills in commercial structures instead of for R&D purposes.⁵³

Market Niches.

There are relevant market niches where SMEs have begun to play increasingly significant roles, in such sectors as software programming, medical equipment, consulting services, etc. The ability of SMEs to respond flexibly to changing market conditions and quickly enter new business areas gives them certain advantages over the large established enterprises that still dominate most existing market sectors. The information technology (IT) and computer programming sector are examples of a new business area where SMEs have led the way in developing new capabilities, enterprises, and markets. For example, it is estimated that the offshore programming sector in Russia may be able to expand at rates from 20-50 percent per year to meet international demand for such services. This sector currently generates under \$100 million in revenues per year in Russia, compared to over \$6 billion in India, as part of a global market that is anticipated to grow to over \$1 trillion per year by 2008. A 1999 McKinsey study found that productivity in the Russian IT project services sector was 72 percent of the productivity of the comparable sector in the United States, which was the highest productivity level in any of the industry sectors evaluated in the study.⁵⁴

Nevertheless, it is interesting to note that Russian companies working in this area face many of the characteristic barriers to SMEs in Russia, including the reluctance of Russian defense-sector programmers to work on more mundane commercial programming tasks even though the pay is significantly better than for work on military-industrial projects, the hindrances of working within security restrictions, low domestic demand, lack of skilled managers, administrative and regulatory challenges, lack of experienced marketing support, and the lack of Russian government support programs.⁵⁵

There are some military-related technology and industry sectors where Russian capabilities remain highly competitive and where small business activities have become visible. Russian technological capabilities perhaps remain most competitive in areas such as aerospace, materials science, computer science, optics, and sensor technologies. Some of these industry sectors saw small businesses emerge in the defense area during the 1990s to compete on the basis of quality and price—examples can be found in areas such as avionics, navigation, software, radio, and personnel protection.⁵⁶

Access to Foreign Markets and Funding.

A wide range of Western donor organizations, led by the EU TACIS, USAID, and EBRD programs, but more recently including the U.S. IPP, NCI, and other programs, have provided significant assistance for SME development in Russia. In many regions, these international donors have provided more funding for SME support than have Russian government programs. While hundreds of millions of dollars have been provided in funding, technical assistance, loan guarantees, etc., it is difficult to evaluate the impact these programs have had on job creation.⁵⁷ There are many programs and support organizations active, but international assistance programs too often are not based on preliminary research or tailored to meet specific needs in

the regions of Russia where they operate. There is continuing uncertainty about the sustainability of many programs started with international funding since most SMEs lack the resources to pay for the training and assistance provided by these programs. Nevertheless, broad programs such as the Morozov Project, Russian Agency for SME Support, Technopark Association, and others have had significant impacts in helping to expand the Russian SME sector. The expanded knowledge of foreign markets and funding sources developed over the past decade has encouraged the creation of SMEs that can obtain funding. Indeed, access to foreign capital or markets is a major indicator of the health of enterprises—regional and national studies have found that most industry leaders have links to international markets or finances.⁵⁸ Foreign funding has played a major role in supporting innovative firms in the aerospace, nuclear, and software industries.⁵⁹

Unfortunately, some of the international programs aimed at nonproliferation have had the unintended consequence of encouraging weapons scientists to remain affiliated with the defense institutes in order to be eligible for funding under those programs. In addition, as we have noted, most of the scientists who receive funding under programs such as ISTC or NCI continue to work on WMD development programs at state defense facilities and receive state salaries.⁶⁰ For example, apparently almost three-quarters of the Russian weapons scientists who received funding from the ISTC in 2000 continued to work at least 60 percent of full-time levels at their other jobs while receiving ISTC support.⁶¹ While programs aimed at providing research grants to weapons scientists may help reduce potential short-term proliferation activities by meeting scientists' needs to earn a living, these programs continue to support the further development of Russia's advanced military and WMD capabilities. This perpetuates the long-term proliferation problem by helping Russian military scientists retain their skills and retain

employment at the large Russian defense sector R&D enterprises.

As one researcher has noted, programs such as the ISTC were originally intended as short-term measures to provide employment for weapons scientists until the Russian economy developed to provide alternative employment for them.⁶² This initial expectation was ill-founded: a decade has passed, and the expected job creation has not occurred. The result has been that Western aid programs are helping Russian weapons scientists retain their military skills, and thus prolonging the potential proliferation situation. For example, a study by Tikhonov reports that 97 percent of the weapons scientists who moonlight to earn foreign stipends say that this work helps them maintain their core job skills, while only 16 percent of those scientists who moonlight for Russian employers say this.⁶³ Other programs such as the NCI, which are aimed at new job creation, have met only limited success in creating new jobs, and most of the Russian scientists involved continue their Russian state-funded WMD development work. Programs should be restructured to encourage aid recipients to leave their employment at state enterprises.

SUGGESTIONS FOR WESTERN ASSISTANCE PROGRAMS

What can be done to encourage the development of the SME sector in Russia and harness entrepreneurial activity to reduce proliferation? Unfortunately, current trends are troubling because the barriers to SMEs are strong and growing, and the facilitating factors are weak. SMEs are primarily active in lower-tech areas, and thus are not as attractive to Russian technologists as military work. The Russian government has demonstrated a strong orientation on increasing the size of large industrial groups, both in military industry and the general economy, and not on supporting the SME sector.

At the broadest level, the distorted regulatory framework is one of the most significant barriers to the development of a more robust SME sector, yet this is also one of the most difficult problems to address. The problematic investment climate has discouraged FDI or even Russian domestic investment in capital projects. Russia's legislative framework regarding property rights, taxation, and labor relations needs to be improved, and enforcement must be improved across the board. While providing targeted tax privileges for science and technology SMEs has not been a standard practice in Western programs, some analysts argue that this type of approach is critical in Russia due to the large and complex tax burden placed on SMEs. An improved economic situation with reduced institutional, administrative, resource, and demand constraints on SMEs would clearly help, but this is a daunting task—systemic reform of the entire Russian economic and regulatory system would be required to address these problems. Nevertheless, at a more limited level, there are a number of ways that Western assistance programs can be modified to help improve the situation somewhat.

Emphasize Market-Driven Commercialization and Business Services.

One of the largest challenges facing many would-be Russian entrepreneurs and scientists is to shift their focus from a technology-push capabilities-driven approach to a market-pull approach. Business and market training, specific market-oriented business services, and the participation of Western industry partners can help prospective SMEs take this market-pull approach. Aid programs also need to focus on market needs and commercialization, and have clear exit strategies that emphasize sustainability. Comparative experiences in other transition economies such as Poland and the Czech Republic have shown that initiatives that shift away from

high-tech efforts and are reoriented towards medium- or low-tech market demand can achieve significant success.⁶⁴

A common thread in many success stories is the direct and early involvement of U.S. or Western industry partners who provide a clear market-oriented approach. Examples include Boeing's Moscow Design Center (which has grown to employ about 650 engineers, scientists, and computer specialists), a U.S. industry software venture in partnership with VNIIEF nuclear weapons lab in Sarov (which has grown to have about 100 former weapons scientists under contract), Motorola and Intel software labs in Russia, and offshore software development companies such as VDI (which has 225 programmers working in its Russian operations for U.S. customers).⁶⁵ These are cases where there was little or no involvement of government-sponsored assistance programs. In fact, such government-led programs can sometimes under-perform compared to private-sector initiatives. For example, while the Sarov Open Computing Center (OCC) created with funding from the NCI program has had some success, most of the work conducted to date has been for the OCC staff to build up their skills or for LANL, yet LANL has reportedly not directly benefited.⁶⁶ This program is now actively seeking industry partners and potential customers, and recognizes that commercialization is the largest challenge facing the NCI.

In contrast, many international assistance programs have been slow to emphasize commercialization and industry involvement. The U.S. Department of Energy (DOE) IPP program, which was criticized for insufficient focus on commercialization, increasingly shifted to a model focused on industry participation in the late 1990s with promising results, and the ISTC has done the same with its Partners Program begun in 1997.⁶⁷ Similarly, the DOE Nuclear Cities Initiative, European Nuclear Cities Initiative, and RANSAC-initiated Nuclear Complex Conversion Consortium are examples of recent steps in this direction, but much more progress needs to be made

towards commercialization and market-oriented programs. Programs must be clearly focused on market demand, avoiding the common approach of focusing on finding U.S. partners for existing Russian products and technologies. U.S. programs could work to focus on market areas where Russian SME products would have a clear market demand. Some examples include supporting the development of Russian SMEs to produce nuclear materials protection, control, and accounting (MPC&A) equipment or specialized technologies for environmental clean-up at DOE sites—these are areas with clear markets in Russia and the United States, involving products that would satisfy U.S. security interests.⁶⁸

Successful policies to support SMEs have also focused on reducing the barriers they face by linking education and entrepreneurship, and by providing services and office space to SMEs. While training programs, business centers, and technoparks can help get SMEs started, the training is often too general or theoretical to be of concrete assistance, and most technoparks are more akin to display halls rather than business incubators.⁶⁹ Russian surveys have found that generally the retraining programs offered by many Western aid programs involving generic business skills or direct application of Western approaches are seen as ineffective in helping recipients work within the Russian economic system.⁷⁰ Focused programs involving specific technical assistance and business consulting services are much better received, and programs to enhance the marketing skills of Russian defense technologists would be most valuable.

Market forces have led most of the employees who have left military industry to go to work in relatively low-tech sectors such as services, trade, and simple consumer goods production. Entrepreneurs looked to those sectors to make money in the 1990s in Russia, not to technology sectors. While some skilled workers and researchers have moved into companies where they use mathematical and computer skills in areas such as computer programming, banking,

and finance, most new enterprises have not focused on these areas. For example, while a study of the commercialization of military R&D capabilities in Tomsk Oblast found a high level of such activity by the mid-1990s, the most successful new enterprises did not seek to apply or develop high-tech products.⁷¹ Instead, many of the most successful experiences with the commercialization of military-industrial R&D capabilities in Tomsk Oblast were oriented towards clear areas of domestic Russian market demand (usually in consumer goods). One of the most successful new enterprises that the Rubin Submarine Design Bureau began in the 1990s, in addition to its work in support of diesel submarine sales to India and elsewhere, was a business center and the Hotel Neptune, where personnel from the design bureau worked as clerks and service personnel. Workers at the hotel report with satisfaction that, despite initial hesitation about leaving the scientific field, their wages are higher than those of the colleagues they left behind at Rubin's design facilities.⁷² Many oft-cited successes, such as the Leninets joint venture with Gillette to produce razors, are also examples of projects where Russian organizations have moved into less-technically advanced commercial areas instead of seeking to apply their R&D capabilities.

Establish Clear Project Goals and Evaluation Guidelines.

As GAO reports and others have suggested, foreign aid programs should have clear project evaluation and approval guidelines, requiring applicants to demonstrate such things as commercial viability and the involvement of industry partners.⁷³ This is made difficult by the continuing poor economic climate and distortions in market mechanisms, which make it difficult to evaluate economic viability of enterprises or identify niches of potential economic growth.⁷⁴ Donor programs should not over-reach in terms of goals for developing sustainable business enterprises. That may not be possible in some locations, such as Russia's

closed cities. Some U.S. programs such as NCI and DEF have disbursed funds before establishing clear program evaluation and approval guidelines tailored to Russian conditions, and have failed to carefully select recipients of assistance. Unfortunately, NCI programs serve as examples of how the lack of clear project goals and criteria can undermine the effectiveness of well-oriented programs.⁷⁵ In addition, program activities should be tailored to take account of each enterprise's economic condition, skill sets, etc. Some enterprises are not viable candidates for support. Their financial situation, physical plant, lack of basic competencies, management problems, or ties to military work may make them inappropriate candidates to receive support, and no amount of Western financial or consulting support would make them viable.

Focus on Regional and Local Level Programs.

Regional and local level programs have proven to be most effective in meeting the needs of small businesses, and encouraging the development of critical partnerships between SMEs and local authorities.⁷⁶ Local initiatives are often the most cohesive and coherent, and do not overreach or turn into enormous centrally-focused industry support efforts. Some SME support programs at the regional level have achieved significant success in developing positive environments for SME expansion, including programs in areas previously dominated by large military-industrial enterprises. For example, local programs in Zhukovskiy (centered on TsAGI), Tomsk, and Zelenograd are some of the ones that have apparently been able to build coherent support communities to encourage broader development of SMEs.⁷⁷ As thousands of personnel left TSAGI in the early 1990s, local employment services encouraged the creation of over 2,000 SMEs that have helped to create over 60 percent of the new jobs in the area. Similarly, an Entrepreneurship Development Department in the Zelenograd region promoted the creation of over 3,000 SMEs with business incubator support, finance programs, and training

programs. By 1997, about 25,000 people were employed in these SMEs, absorbing some of the 40,000 workers whose numbers in the local microelectronic industry were reduced in the mid-1990s. Another local initiative in Tomsk, the Tomsk Business Partnership, has built on the region's positive record of SME support to provide both specialized training and consulting services for SMEs and increased access to investment capital.

Reduced Focus on Short-Term Assistance to Employees at Large or State Enterprises.

Western nonproliferation programs should shift their focus to working with and promoting SMEs and small business consortiums, instead of remaining tied to the large defense sector R&D institutes and industrial enterprises. Encouraging specialists to move to the private SME sector can help reduce the capabilities base of the Russian defense sector, thereby reducing its influence in Russian affairs and reducing the excessive capabilities that seek markets. To encourage this, international donor programs should shift their focus to industry-focused or Russian domestic-style orders, and move away from short-term grants. In addition, major assistance and collaborative programs can better reduce some proliferation concerns by focusing on working with Russian SMEs rather than large enterprises. Unfortunately, some programs such as that for international space cooperation have served to provide significant funding to Russia's large state-run space R&D enterprises, helping them increase salaries and attract skilled young specialists, yet not being able to prevent the proliferation of missile technologies from those enterprises to countries such as Iran. The organizational health and skill sets of specialists at some key Russian missile facilities are better than that at many nuclear weapons enterprises, in part due to the foreign funding provided through international space cooperation projects.⁷⁸ For example, in contrast to the situation at most other defense sector enterprises, wages are relatively high and the proportion of

younger specialists is growing at the Energiya Corporation, which has been heavily involved in the international space station project. While numerous other international assistance programs developed to promote the growth of Russian SMEs have played a positive role by providing short-term grants or free business support services, their long-term sustainability is uncertain once foreign funding is reduced.

Unfortunately, some productive short-term responses to the immediate problems affecting Russia's defense scientists, such as the grant programs run by the ISTC and others, have been continued beyond their initial scope due to ongoing economic problems in Russia. In effect, these types of programs encourage the recipient scientists to retain their ties to state-run defense R&D institutes in order to remain eligible for funding. At the same time, many of the scientists continue working on defense-related projects, such that the grants support the continued maintenance of Russia's military-related technical skills and institutes. For example, while the U.S. programs to engage Russian biological weapons scientists in nonmilitary projects have discouraged these scientists from proliferating their skills, these programs, by aiding institutions and subsidizing equipment, may also have served to sustain the scientists' relevant military skills and enhance a possible long-term reconstitution threat.⁷⁹

Compared to other SMEs, those working in the scientific area have the highest percentage of people who have retained their full-time jobs with their previous employers while taking a second job in a small business, with only 30 percent of those working in science-related SMEs doing so on a full-time basis.⁸⁰ This issue raises serious considerations for planning assistance programs because short-term assistance to personnel likely to remain employed at the state organizations may prolong or worsen the longer-term proliferation problem. Programs focused on research grants and finding support for Russian capabilities generate only short-term benefits, rather than

the longer-term benefits that can be obtained by market-focused programs that encourage SME growth.

Improve SME Access to Finance Sources.

As noted, the lack of access to financial resources is one of the key barriers continuing to hamper the development of the SME sector in Russia. Many successful OECD SME support programs have focused on providing finance instruments such as specialized banks and loan guarantee programs for SMEs. These programs need to be application-driven, with merit-based evaluations leading to provision of small seed capital to SMEs seeking to start new enterprises or upgrade capabilities. For example, the Fund for Small Enterprise Development Assistance in Science and Technology has provided subsidized loans to many SMEs, but it handles only about \$4 million in loans a year.⁸¹ There is justifiable reluctance on the part of some donors to provide finance programs until the macroeconomic policy environment and governmental regulatory systems are improved, but focused OECD and other programs provide examples of how such programs can be successfully implemented even without macroeconomic policy improvements.

Beware of Dismantling SME Barriers that Discourage Proliferation.

On a final cautionary note, it is important to recognize that under some conditions, some of the factors that discourage entrepreneurial activity also serve to discourage some types of proliferation. For example, while security restrictions, administrative barriers, lack of financing, and the passivity of many Russians are all factors that hamper the expansion of the SME sector in Russia's closed cities, these same factors also hamper potential access to these cities by undesirable foreign actors and restrict the movement of individual weapons specialists out of those closed cities. Commercial trade activity by companies that

have rented space in newly-accessible buildings associated with Russian nuclear weapons facilities has increased the degree of poorly-regulated trade in the immediate proximity of facilities and materials of proliferation concern. Programs to encourage the creation of consulting groups and firms by weapons scientists can help them develop business skills for commercial work, but also provide them with mechanisms they could use for proliferation of their military skills. Thus, those proposing programs to promote the expansion of entrepreneurial activity and the SME sector need to consider this duality when seeking to reduce some of the barriers that SMEs face. This subject is discussed further in the Appendix to this chapter.

ENDNOTES - CHAPTER 7

1. This issue is discussed in more detail in the Appendix to this chapter.

2. While there has been significant demilitarization, there has not been any significant conversion. The decline in military output has not led to the productive reallocation of freed-up resources to boost civilian production. See John S. Earle and Ivan Komarov, *Measuring Defense Conversion in Russian Industry*, Stockholm, Sweden: Stockholm School of Economics SITE, 1998, pp. 4-5, available online at www.hhs.se/site/Publications/workingpapers/workingpapers.htm; Kevin O'Prey, *A Farewell to Arms? Russia's Struggles with Defense Conversion*, Washington, DC: The Brookings Institution, 1995, pp. 12-14. Many U.S. programs aimed at assisting in the conversion of the Russian defense industry also met with little success. For example, high-profile programs such as the U.S. DSWA-run Fast Four conversion effort and the Defense Enterprise Fund (DEF) expended significant funds but largely failed to achieve their objectives. See U.S. General Accounting Office (USGAO), *Cooperative Threat Reduction: Status of Defense Conversion Efforts in the Former Soviet Union*, Washington, DC: GAO/NSIAD-97-101, April, 1997; Matt Bivens, "Investing, Pentagon-Style," *Moscow Times*, April 4, 2001; Sergey K. Kolpakov, "The Era of East-West Joint Ventures," in Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion*, Walnut Creek, CA: VEGA Press, 2001.

3. Comparisons across countries and time periods are hampered by differing definitions of "small" and "medium" sized firms. In Russia,

legal and regulatory changes in 1995-96 changed the definitions for “small business,” reducing size limits for some sectors from 200 to 100 employees for industry and construction (the maximum size is 60 for R&D, 30 in trade and services, etc.) and requiring that the share of ownership by entities outside the company (governments, NGOs, other legal entities) be less than 25 percent. The Russian definition of a “medium” business is one having 100 to 300 employees. See Leonid Polishchuk, *Small Business in Russia: Institutional Environment*, Publication No. wp240, University of Maryland, College Park: Center for Institutional Reform and the Informal Sector, 2000; S. A. Smirnov, *Maloye Predprinimatel'stvo: Obshchestvennaya podderzhka I sodeystvie razvitiyu*, Moscow: TOO KONTUR, 1999, pp. 45, 73; *Resursnyy Tsentral Malogo Predprinimatel'stva* (RTMP), *Rossiskoye maloye predprinimatel'stvo v tsifrakh*, Moscow: RTMP, 2000, available online at Docs.rcsme.ru/rus/RC/statistics (hereafter RTMP, 2000a); OECD Centre for Co-operation with the Economies in Transition (CCET), *Entrepreneurship and Small Business in the Russian Federation*, Paris: OECD CCET/DT(9811), February 20, 1998, section 1.3. In the EU, SMEs are defined in terms of employment as having less than 250 employees.

4. Polishchuk and Smirnov note the number of SMEs fell to 3.6 per 1000 population in Russia after the 1998 crisis.

5. Controls on private enterprise were loosened somewhat during the period of Gorbachev's rule and perestroika. The 1988 Soviet Law on Cooperatives opened the door for internal spin-offs within state enterprises, and many entrepreneurs made use of this law to open small consumer-oriented cooperatives.

6. While official employment figures do not include firms in the underground economy or firms that under-report to avoid taxes, this omission is offset by the inclusion of nonperforming and “shell” firms set up for other reasons, so that some analysts feel the official numbers are a reasonable reflection of the actual situation. See Polishchuk; and OECD CCET (1998), esp. section 1.3. Surveys have also recognized the stalled SME sector. See Theodore Gerber, *The Development of Self-Employment in Russia*, Program on New Approaches to Russian Security, PONARS Memo no. 186, 2001, available online at www.fas.harvard.edu/~ponars.

7. See OECD CCET, p. 35, on innovative SMEs; and Polishchuk, section 3.1. Most SMEs in Russia are in the trade sector (43 percent of all SMEs in 1996), construction (17 percent), and industrial production (metal working, light industry, wood manufacturing, food industry, 15 percent), while scientific services make up only 6 percent of the total.

While innovative businesses are not registered in Russian statistics, it is estimated that in 1996 some 40,000 firms were involved in creating new production methods or new technologies, with 4,000 of those dealing with scientific services.

8. *Kommersant*, 3/16/00, as cited in Polishchuk, p. 4; OECD CCET, esp. section 1.5.

9. This section draws on Polishchuk's excellent survey of SME, as well as Gonchar; RTMP, 2000a; RTMP, *Issledovaniye administrativnykh bar'yerov*, Moscow: RTMP, 2000, September available online at www.rcsme.ru (hereafter RTMP, 2000b); OECD Centre for Private Sector Development (OECD CPSD), Forum on Entrepreneurship and Enterprise Development: Report on Meeting of Working Party I on Institutional Framework for Entrepreneurship, Paris: OEDC, March 1998.

10. See analysis in RTMP, 2000b.

11. McKinsey Global Institute, *Unlocking Economic Growth in Russia*, chap. 3, "Software" section, and exhibit 13, 1999. Available online at mgi.mckinsey.com/mgi/russian.asp.

12. O'Prey, p. 20.

13. For example, see discussion in Stanislav Menshikov, "Stsenarii razvitiya VPK," *Voprosy Ekonomiki*, July 1999, on approaches in the scientific-industrial complex.

14. See N. Tsagolov, presentation at January 20, 1999, conference on "Obsuzhdeniye problem kommersializatsii NIOKR," sponsored by ECAAR-Russia, on commercialization of R&D (NIOKR); Nonna Barkhatova, "Russian Small Business, Authorities and the State," *Europe-Asia Studies*, June 2000.

115. See U.S. Government Accounting Office, *Nuclear Nonproliferation: DOE's Efforts to Assist Weapons Scientists in Russia's Nuclear Cities Face Challenges*, Washington, DC: GAO-01-429, May 2001, p. 21 and Appendix III.

16. Gonchar, p. 19; Barkhatova; and Polishchuk.

17. This has been particularly problematic in the defense sector, as enterprises have sought to "convert" only to find too many firms chasing small market niches. See Yevgeny Kuznetsov, ed., *Learning to Restructure: Studies of Transformation in the Russian Defense Sector*,

BICC Paper no. 3, Bonn: Bonn International Center for Conversion, 1996, Part I.

18. McKinsey Global Institute, as cited in Gonchar, p. 20.

19. McKinsey Global Institute, p. 6, evaluated how continuing government subsidies and dominance of well-connected large legacy enterprises hinder the growth of potentially productive new companies.

20. Judith B. Sedaitis, "Commercializing State-Owned R&D: A Russia-United States Comparison," and Andrew J. Aldrin, "Defense Enterprise Adaptation in St. Petersburg," in *Commercializing High Technology: East and West*, Judith B. Sedaitis, ed., New York: Rowman & Littlefield Publishers, 1997, cite these factors, suggesting that they may help account for why Scientific Research Institutes (NII) have been less open to reorganization and new approaches than Design Bureaus (KB), and why KBs have been less open to restructuring than Scientific Production Associations (NPO) and Production Associations (PO).

21. CENTRA project experiences; see also Ross Kerber, "To Russia With Cash," *Boston Globe*, May 7, 2001.

22. For example, see discussion in David M. Bernstein, "Toward Cooperative Ventures with Russian Defense Enterprises," in Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion*, Walnut Creek, CA: VEGA Press 2001, p. 670.

23. For example, see Barkhatova.

24. Valentin Tikhonov, *Russia's Nuclear and Missile Complex: The Human Factor in Proliferation*, Washington, DC: Carnegie Endowment for International Peace, 2001, pp. 55-57, or online at www.ceip.org/npp.

25. Gonchar, p. 29; Polischchuk; and Leonid Ya Kosals, Rozalina R. Ryvkina, and Michael D. Intriligator, "Russia's Defense Enterprises: Between the State and the Market," in Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion*, Walnut Creek, CA: VEGA Press, 2001, argue that privatization has not provided effective new owners.

26. O'Prey, p. 48.

27. *Ibid.*, pp. 61-68, notes the resistance of defense industry managers to change, and their continuing ability to stifle alternative developments, as one of the major reasons for the failure of conversion and reform in the Russian defense sector.

28. See comments of Clifford Gaddy and Glenn Schweitzer in Glenn Schweitzer and Lev Tocheny, "Nuclear Perestroika: Techno-Business in Russia's Atomic Cities," presentation at MIIS Center for Nonproliferation Studies seminar, February 23, 2001, available online at ransac.org/new-web-site/ccc/nuclear_perestroika.doc. For example, VNIITF created the SPEKTR joint stock company for commercial projects, but recent reports indicate that most VNIITF workers have been recalled back to the lab because the lab director wanted a larger defense work force to ensure more Minatom funding. For a presentation on job creation in the closed cities, see Sharon Weiner and Oleg Bukharin, "Job Creation Efforts by the Closed Cities," at RANSAC Workshop on New Perspectives on the Future of the Russian Nuclear Weapons Complex, held December 19, 2000, available online at ransac.org/new-web-site/ccc/dec_workshop.doc.

29. See L. Konareva, presentation at January 20, 1999, conference titled "Obsuzhdeniye problem kommertsializatsii NIOKR," sponsored by ECAAR-Russia, on commercialization of NIOKR.

30. Some examples of such organizations include Leninet's Holding Company, Rubin Marine Design Bureau, Ioffe Robotics NII.

31. Gonchar, 1998, p. 49.

32. Gonchar, 1997; Menshikov, 1999b; Earle & Komarov, p. 12, citing Glukhikh. See Yu. V. Perevalov, et al., *Konversiya I restrukturizatsiya oboronnogo kompleksa: regional'nyye problemy I perspektivy*, Yekaterinburg: Institut ekonomiki UrO RAN, 1998, p. 5; Menshikov, 1999b, on size of defense R&D sector.

33. For example, see Gansler, 1997; and Sedaitis, 1997.

34. Gonchar, 1997, has undertaken valuable work to compile official and unofficial data to help get a better picture of this activity, while Gansler, 1997, and Aldrin, 1997, have written on the separation of NII, KB, NPO, etc.

35. O'Prey, pp. 16-21; Kosals, et al., 2001, note the continuing dominance of large firms in defense sector.

36. Gonchar, p. 49; Harley Balzer, "Dismantling Russia's Technopia: Six Ministries in Search of an Industrial Policy," in Judith B. Sedaitis, ed., *Commercializing High Technology: East and West*, New York: Rowman & Littlefield Publishers, 1997.

37. Leonid Kosals, "Retsept Vyzhivaniya Oboronnogo Komplksa" ["A Prescription for Survival of the Defense Complex"], *Nezavisimaya*

Voyennoye Obozreniye, January 28–February 3, 2002, as cited in Gonchar, p. 49.

38. CENTRA personnel visits; Menshikov, 1999b.

39. For example, see Gonchar, pp. 16ff.

40. Gonchar; Aleksey N. Shulunov, “Symptoms of Paralysis,” in Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion*, Walnut Creek, CA: VEGA Press, 2001, p. 345; and others estimate that arms exports make up about 60-70 percent of all Russian defense industry military sales. For example, Gonchar, Figure 8, shows that in 1998 arms exports accounted for up to 84 percent of the military output of the aerospace sector and 59 percent of the shipbuilding sector.

41. See, for example, the Deputy Prime Minister Klebanov initiative as reported in V. Zmeyushchenko and Ye. Titova, “The New Line of the Defense Industry,” *Profil* 5/7/01, as cited in *Foreign Broadcast Information Service (FBIS)-CEP* 20010507000275, 2001; Dmitriy Safonov, “Military-Industrial Complex Is In for Revolutionary Upheavals,” *Izvestiya*, March 29, 2001, in *FBIS-CEP* 20010329000312, on defense industry reforms; statements of Directors of the Russian Armaments Agencies in “The Defense Complex’s Today and Tomorrow,” *Krasnaya Zvezda*, December 23, 2000, as cited in *FBIS-CEP* 20010103000217; and Alan Cullison, “Merger Mania Hits Russian Economy, and Anti-Monopoly Minister is Smiling,” *Wall Street Journal*, June 6, 2001.

42. Author interviews with remote sensing and information technology specialists who previously worked on classified projects in Moscow-based institutes, 1999, 2000, and 2001.

43. Tikhonov, *Russia’s Nuclear and Missile Complex: The Human Factor in Proliferation*, Washington, DC: Carnegie Endowment for International Peace, 2001, Section 6, or online at www.ceip.org/npp. It is estimated that 6 to 10 million people worked in Russia as part of the Soviet defense industrial sector in the late 1980s, but that by 1994 this was down to 4.5 million people, falling to 3-4.5 million in 1995, and then 2.7 million in 1997. See Gonchar as cited in O’Prey, p. 45; Menshikov; Earle and Komarov, p. 12, citing Cooper, Glukhikh, and others; Shulunov, p. 387. Noting that the number of inventions has fallen significantly, see Arkadiy Yarovskiy, “Brain Drain: The Loss of Intellectual Capital,” in Vlad E. Genin, ed., *The Anatomy of Russian Defense Conversion*, Walnut Creek, CA: VEGA Press 2001, p. 388.

44. Earle and Komarov, citing official Russian government data.

45. Author interviews with Department heads at MFTI, Bauman, ITMO, and ex-LETI in 1992, 1995, and 1996. See also Gonchar, p. 37.

46. Putin speech of March 21, 2000, in Nizhny Novgorod, *Economic Reform: The Case of Nizhniy Novgorod Oblast*, Paper 14, Bonn, Germany: Bonn International Center for Conversion, May 2000, available online at www.bicc.de/info/briefs.html.

47. Menshikov, "Stsenarii razvitiya VPK," *Voprosy Ekonomiki*, July 1999.

48. Gonchar, pp. 44-45ff. Within this overall decline, some sectors stand out as having relatively high continuing military production—in 1999 the shipbuilding sector's military output was still at 50 percent of its 1991 level, space was at 41 percent, and military output in the nuclear and radio industries was at 34 percent of the 1991 level. In contrast, military output in 1999 was under 15 percent of the 1991 level in the electronics, communications, and aircraft industries.

49. Gonchar, 2000.

50. Kosals, *et al.*, 2001.

51. For example, see World Bank/UNESCO data as reported in American Chamber of Commerce in Russia, *Whitepaper on Offshore Software Development in Russia*, 2001, pp. 9-12, www.amcham.ru, which notes continuing high enrollment in science programs and international recognition that Russian technical students continue to attract in international competitions, etc.

52. Author interviews with MFTI, St. Petersburg Electrotechnical University and other directors in 1994-96.

53. For example, interview with ex-Ioffe First Deputy Director Grigor'yev, 1994.

54. McKinsey Global Institute, 1999, Software chapter.

55. American Chamber of Commerce in Russia; Kerber, 2001.

56. For example, Gonchar, p. 53, points to companies such as Russkaya Avionica, Kronshtadt, Transas, and others.

57. Numerous studies have reviewed international aid programs, but find it difficult to quantify results. For example, see OECD CCET, 1998, section 3.6.

58. Gonchar, 1998, p. 40.

59. For example, see Gonchar, 2000, p. 44.

60. U.S. General Accounting Office, *Biological Weapons: Effort to Reduce Former Soviet Threat Offers Benefits, Poses New Risks*, Washington, DC: GAO/NSIAD-00-138, April 2000. USGAO, 2001, notes some of the problems the NCI has encountered in its start-up phase, and the lack of clear plans or assessment measures to ensure that funded projects meet program objectives of job creation.

61. Calculated from data published in the ISTC Annual Report, 200, p. 7.

62. Tikhonov, "The Nuclear Brain Drain Continues," *Moscow Times*, May 15, 2001.

63. Tikhonov, *Russia's Nuclear Missile Complex*, 2001, p. 75.

64. For example, see studies by Bernstein, 2001; Gansler, 1997; and assessment of USAID New Business Development Program activities, 1993-1997, in International Labour Organization, a report on business development services in Russia. International Labour Organization, 2000, available online at www.ilo.org/public/english/employment/ent/papers/russia.htm.

65. See Kerber, 2001; USGAO, 2001, p. 44; McCullough, 2001.

66. USGAO, 2001, p. 16; U.S. Department of Energy (USDOE) Nuclear Cities Initiative Program Plan, Washington, DC: USDOE National Nuclear Security Administration, 2000, available online at nci.nn.doe.gov. Ascribe News 2001, "New York Engineering Software Firm Signs Contract with Computer Center in Russian Closed Nuclear City," March 30, 2001, notes a recent NCI success with the signing of an \$84 thousand contract to provide computer modeling support for a U.S. company.

67. For example, see USGAO, 2000; USGAO, 2001, for criticism of IPP; and ISTC, 2000.

68. These ideas have been generated by RANSAC programs, as in Bukharin, Bunn, Luongo RANSAC report, 2000, and are being pursued by the Identification Technologies Company based in Snezhinsk that is getting support from the DOE NCI—this is an example of a high-tech market niche for Russian SMEs.

69. Vadim Radayev, presentation at January 20, 1999, conference titled “*Obsuzhdeniye problem kommersializatsii NIOKR*,” [Discussion on Problems of Commercializing R&D] sponsored by ECAAR-Russia, held at the Institute of International Economic and Political Research (IMEPI), Russian Academy of Sciences.

70. For example, see Gonchar, 1998, chap. 5, surveys from Nizhny Novgorod Oblast.

71. Radayev, 1999a, reports on OECD-funded study in Tomsk Oblast. See also Maksim Masharuyev, “Technology Offers Opportunities in Tomsk Oblast,” *BIZNIS Bulletin*, March 2001, on technology opportunities in Tomsk Oblast.

72. Author’s discussions during several visits to Rubin and stays at their Hotel Neptune in the mid-to-late 1990s.

73. USGAO, 2001.

74. Discussed in Gonchar, 1998.

75. USGAO, 2001.

76. OECD CCET, 1998; and OECD CPSD, 1998.

77. OECD CCET, 1998, chap. 3. Also see Alan Moseley, “The Tomsk Business Partnership,” in Eurasia Foundation, May, 2001, on Tomsk.

78. Tikhonov, 2001a. See also Michael Eisenstadt, “Russian Arms and Technology Transfers to Iran: Policy Challenges for the US,” *Arms Control Today*, March 2001, for discussion of Russian organizations allegedly assisting Iran missile program.

79. See USGAO, 2000.

80. OECD CCET, 1998, p. 36, Table 6.

81. *Ibid.*, chap. 3, contains numerous examples of such programs, but many of them are small, not coordinated, and not focussed on R&D or projects coming out of the defense sector.

CHAPTER 7

APPENDIX

POTENTIAL IMPACTS OF SME EXPANSION ON PROLIFERATION

At the most basic level, any supply-side strategy to reduce the proliferation of strategic weapons and technology from Russia can seek to eliminate Russian capabilities of concern, or to discourage those in Russia who possess those capabilities from proliferating them. Demilitarization leading to the total elimination of advanced Russian R&D or production capabilities in a certain military-technical area would eliminate Russia's ability to proliferate in that area, but it is not clear that it is possible or advisable to seek such a total degree of demilitarization.¹ While some military-related assets and capabilities can be reduced or eliminated within a relatively short time span, other assets are more durable or easily reconstituted. For example, military-industrial and R&D capabilities can decline rather quickly when core teams of personnel break up, production equipment ages or is put to other uses, or military scientists and technical personnel begin working on civilian projects and begin to lose their cutting-edge skills.² Nevertheless, some core WMD knowledge can remain of proliferation concern for decades even if the specialists are not actively developing or using the related skills, and it is highly unlikely that Russia will forfeit or lose its ability to produce advanced strategic weapons.

Thus, we need to consider what types of activities, conducted by whom, should be addressed in order to discourage Russian proliferation of key capabilities or

weapons systems abroad. For example, while the proliferation of operational weapons systems requires that the Russian government sell weapons from its stockpiles or that enterprises produce these weapons, the proliferation of scientific-engineering expertise simply requires individuals who possess specialized knowledge and are willing to provide it to foreign customers. While a full explication of all the factors that can encourage proliferation behavior by Russian state bodies, enterprises, groups, and individuals is beyond the scope of this chapter, it is important to identify these domestic factors in order to consider how an expansion of Russian entrepreneurial activities may affect them.

At the central government level, Russian proliferation activities are encouraged by such factors as the pursuit of strategic national interests, hard currency earnings, and alliance relations. At the ministry or enterprise level, weapons proliferation may allow organizations to maintain core production capabilities or skills, earn higher profit margins than in alternative activities, avoid restructuring or retooling, retain influence, pursue parochial interests, and take advantage of existing marketing capabilities. At the individual level, weapons proliferation can enable military-industrial directors, staff, and scientists to continue activities they know and like, earn money, avoid the need to seek new employment, retain influence, and follow belief systems. The motivating factors above are not independent of each other—some are interrelated—but they are distinct enough to be treated as separate drivers of proliferation activity. Many of these powerful domestic factors can act to encourage continued Russian proliferation activities even in the face of international opposition, control regimes, or significant demilitarization at home.

How could expanded entrepreneurial activity affect the factors that encourage proliferation behavior by the Russian government, enterprises, or scientists and other individuals? A summary of these influences, with each rated from minimal to significant, is shown in Table A-1. At

the state level, Russia's perception and pursuit of its national interests or alliance relations are unlikely to be affected by an expansion in SME entrepreneurial activities. It is conceivable that a major expansion of the SME sector in Russia could shift the sources of influence in the Russian political system, give new actors a greater voice, and lead to a revision in how the Russian government perceives its national interest, thereby reducing the attractiveness of weapons proliferation for Russian policymakers, but these eventualities must be considered highly unlikely. Thus, an expanded SME sector would have insignificant impact on these factors that promote proliferation. Similarly, the government's incentive to export arms in order to earn hard

Level	Factors Encouraging Proliferation	Potential Impacts of Expanded SME Sector
Government	Leaders view arms sales as being in the national interest and a tool to support alliance relations	Minimal
	Leaders view arms sales as an effective way to earn hard currency	Minimal
	Government seeks to put excess military industrial and technical capacity to use	Moderate
Ministry/ Enterprise	Organizations seek to maintain core military-related production capabilities and skills.	Minimal
	Traditional military-industrial views and organizations are influential within the government	Moderate
	Organizations view arms sales as a good way to increase revenues and profits, provide employment for personnel, maintain influence, and avoid need to convert or restructure.	Moderate
	Access to foreign arms markets is aided by active and experienced marketing organizations.	Moderate
Individual	Workers have ideological beliefs about supporting recipient governments or nonstate groups	Minimal
	Workers enjoy and feel competent in military work.	Moderate
	Workers view military work as best way to earn money, remain employed, and retain social position.	Significant

Table A-1. Potential Impacts of SME Expansion.

currency will not be directly affected by an expansion in entrepreneurial activities, unless this expansion leads the Russian government to be more concerned than it would be otherwise about Western sanctions in response to Russian proliferation activities. Potentially the largest impact that expanded entrepreneurial activities might have on proliferation drivers at the government level would be if the expansion of SME activities reduced the need to find alternative uses for excess military-industrial and technological capacities. In this way, expanded SME activities could moderately reduce incentives for the Russian government to proliferate for this reason.

At the ministry or enterprise level, an expansion in entrepreneurial activities can have somewhat greater impacts because it would directly address some of the key factors that encourage proliferation by actors at this level. For example, a robust SME sector could reduce the influence of the traditional military-industrial complex, and thus reduce the ability of these ministries or enterprises to successfully advocate foreign arms sales. Similarly, expanded entrepreneurial activities could provide alternative sources of employment and profits for enterprises, but are likely to reduce the attractiveness of arms sales in this regard only if the large organizations believe they can remain influential and in control as SME activities increase. An active SME sector could also develop better access to critical foreign markets, thus providing alternative market access to that provided by Rosoboroneksport. Nevertheless, it is hard to envision how an expansion in SME activities would reduce the incentives for industrial ministries or their production enterprises to export weapons abroad in order to maintain core military production capabilities and skills or to retain their influence.

In terms of individual scientists and other personnel, an expanded SME sector could have major impacts in reducing the importance of proliferation drivers that act at this level. A flourishing SME sector could provide alternative sources

of employment, salaries, and social influence to reduce individuals' reliance on military-related work supported by foreign arms sales revenues. While some job positions in the SME sector can provide interesting and challenging work for technical personnel, this may have only a moderate impact on reducing the attractiveness of military-related work because many SME positions in Russia are likely to be in lower-tech sectors or involve work that individuals find less intellectually interesting than their previous work in defense R&D. Finally, at this level it is unlikely that SME activities will reduce the role of ideological beliefs in promoting arms sales, but this is probably a rather minor driver of proliferation activity.

Thus, as indicated in this overview, it is likely that an expansion in Russia's SME sector can play a role in reducing proliferation activity in Russia, but there are also significant factors encouraging proliferation that would not be affected by an expanded SME sector.

ENDNOTES - APPENDIX

1. Many Russian analysts and officials are concerned that Russia's military-technical capabilities are declining to such low levels that they may fail to support Russia's stability and basic national interests. For example, Tikhonov, 2001a, argues that the lack of skilled technical personnel and industrial capacity in the nuclear weapons and power sector may threaten Russia's ability to safely manage its nuclear weapons stockpiles or nuclear power industry.

2. Personnel who shift to work on civilian projects often lose their technical qualifications because the civilian work is less advanced than the military work. For example, Russian military-industry directors have noted in interviews that work to design, weld, and produce civilian tankers is simpler and less demanding than the work involved in producing submarines.

CHAPTER 8

TURNING THE NEXT GENERATION OF RUSSIAN WORKERS AWAY FROM WEAPONS WORK

Thomas Riisager

Since the early 1990s, U.S.-Russian cooperative nonproliferation programs have been bent upon reducing the size of Russia's nuclear complex by finding alternative employment for tens of thousands of workers currently employed as weapons specialists. These programs are helping demilitarize Russia but will fail to achieve their stated goal so long as future generations of scientifically talented Russians are more attracted to working in the defense complex than in the private sector. The forces that push younger Russians towards state employment, after all, are the same forces that make it practically impossible for older generations—the focus of Nunn-Lugar programs—to transition out of weapon work.

Certainly, channeling Russian youth away from employment in these facilities is worth pursuing now.¹ Over a third of Russian university students recently surveyed would consider working at a nuclear industry enterprise in a closed city. More troubling still, over 60 percent of the best students would actually prefer to work at a state enterprise.²

In this chapter, I examine four principal obstacles to attracting these younger workers to the private sector. The first is the prevalence of corruption in Russia, which

increases the costs of starting and maintaining businesses, and discourages the foreign investment enterprises need. The second is that Russians still lack an entrepreneurial work ethic, which is caused in part by the third obstacle, an overbearing management style prevalent in Russia. Finally, Russia's current laws and institutions hinder attracting young workers to the private sector because, instead of fostering economic growth, they have up until recently been totally at war with private business.

Although serious, these problems can be overcome. In fact, multinational corporations with business concerns in Russia have developed several successful methods of training their Russian employees to work within Western business norms. These corporations discovered that their younger local hires, when exposed to a Western work culture, are less inclined to cheat or steal, eagerly seek out responsibility, and have developed a more sophisticated view of modern business. They found that Russians over 35 years of age, however, do not adapt as readily and require special management. These corporations' experience suggests a number of specific recommendations for how to reform future nonproliferation programs, including increased emphasis on business and academic exchanges with the United States and Europe, and legislative changes the Russian government can make to ease the burden on small and medium sized enterprises.

Corruption Cripples Russia's Private Sector.

The prevalence of corruption is arguably the biggest obstacle to entrepreneurial development in Russia. Paying for Mafia protection and bribing corrupt officials greatly increase the costs of starting and maintaining even the smallest enterprise. On a larger scale, crime in Russian business contributes to negative stereotypes about Russian workers and discourages foreign investment needed to expand the private sector.

The propensity towards corruption has historically been high in Russian culture and is generally an accepted part of life. Its prevalence has been attributed to both the state's inability to enforce laws and the average Russian citizen's desperation for survival.³ Corruption in Russia can be traced to the Czarist era when peasants were largely left to police themselves through a form of lynch law known as *samosud*, or self-judging. In *samosud*, actions that threatened the security or the social order in the community were punished very severely.⁴ On the other hand, crimes against outsiders or the Crown, for example, tax dodging, were accepted, as they had no immediate negative impact on the community. The state disliked the idea of peasants policing themselves, but it lacked the legitimacy and resources to enforce laws across such a vast country.⁵ Meanwhile, within the state's own organs, low-paid civil servants were actually expected to supplement their incomes by *kormlenie*, or feeding off of their jobs, whether by accepting bribes, running private businesses on the side, or appropriating state assets.⁶ Thus developed a culture of acceptable criminality.

Instead of putting an end to this corruption, the Revolution of 1917 only broadened its scope. The Communist Party relied on criminal groups to bypass bottlenecks and shortages in the hopes of meeting production demands. Soviet citizens, too, were forced to turn to crime in order to survive, whether by selling goods on the black market or stealing goods from the state.⁷

Given Russia's past, it is not surprising that what is considered corrupt by Western standards is business as usual in that country. For example, there is a nearly universal practice in Russian businesses to maintain two sets of financial books: the first set contains accurate account records for in-house use only; the second set of numbers reflects a much lower profit margin for the benefit of tax reporting. The rationale is a throwback to *samosud*, where evading taxes, though illegal, was not "wrong." Among Russian businessmen, this practice is not only

acceptable, it is expected. Accountancy staff that process these records are usually aware of the illegality, but seldom question the morality of doctoring the books, much less the long-term negative impact.

Corruption's effect on business in Russia is very serious. Daily business practices lack the required transparency to attract investors. In the 21st century, a potential investor expects a company's financial records to present a fair and accurate picture of the enterprise's financial status and market competitiveness. Since the decision to invest in a company is largely based on these reports, opacity or lack of confidence in their legitimacy will adversely affect that decision.

PricewaterhouseCoopers estimates that Russia loses about \$10 billion in direct foreign investments a year due to its high opacity index.⁸ Arthur Haigh, PricewaterhouseCooper's managing partner, said in an interview with *Kommersant Daily* that Russia's integration into the world economy and the attraction of much needed investment may accelerate, but only if the management of Russian companies begins to practice the principles of good corporate governance.⁹

Corruption is prevalent at all levels of business. A recent example at an international accountancy firm in Moscow illustrates this point. To be certified, an accountant must pass a series of rigorous exams. If an accountant fails, he or she will most likely be dismissed from the firm. During a recent exam, one of the examinees was found to be cheating and was confronted with the evidence by his superiors. Neither embarrassed nor disturbed by the accusation, he admitted to the cheating, and expressed surprise only when he learned that he was being fired as a result. The employee's reaction concerned the expatriate staff, which promptly arranged interviews with the other trainee accountants about the incident. The interviews showed that the locally hired staff viewed cheating on tests as acceptable behavior and felt that being fired for it was overly severe.¹⁰

Getting caught cheating was simply a matter of not cheating well enough.

Such stories are rampant among companies with business concerns in Russia, further strengthening the negative stereotype of Russians as untrustworthy employees and business partners. Although this anecdotal evidence seems to prove otherwise, the problem is not based on an inherent lack of honesty or integrity by Russians, but is simply a matter of differing cultural definitions of what is acceptable. History and necessity have created a quite different set of norms for Westerners as compared with Russians, but until Russian work culture adopts the business norms of the industrialized Western nations, this stereotype will continue to pose an obstacle to Russia's proper integration into the world economy.¹¹

The Russian Work Ethic's Traditional Lack of Entrepreneurialism.

The Russian work ethic evolved in a command economy, not a developed free market system, and the Russian worker has had little time to adapt to the end of communism.¹² The employee's place in the Russian work culture and the role of the employer, therefore, are viewed differently than in the West. A reasonable employment situation by Western standards, in terms of job security and benefits, would not meet the expectations of a Russian accustomed to the labor process of the Soviet planned economy.

For over 70 years, the Soviet citizen could count on a minimal, but secure, standard of living. Health care and education were provided free of charge by the state, and every citizen was guaranteed employment.¹³ According to Soviet law, it was, in fact, a crime not to be employed.¹⁴ Full employment in the Soviet system allowed the government to pass social welfare responsibilities to individual enterprises, which provided housing, food, daycare, and other benefits. The monetary portion of income was far less

important to the survival of the employees than these subsidies, since low wages were offset by price controls that made the necessities of life available to the majority of the population at prices they could afford.¹⁵

In this system, after completing a state-sponsored education, a citizen would be placed in a position chosen on the basis of current labor needs and his or her skills. Once employed, the citizen could count on having that job indefinitely. If a worker found himself or herself “unemployed,” his or her last employer (and not the state) would be responsible for paying any unemployment benefit. Changing enterprises was virtually a risk-free venture for the worker; he or she would be able to move on to a different company after completing the mandatory service term. Separate enterprises were, after all, only different faces of the same entity—the state.¹⁶

Although the socialist system collapsed in 1991, its effect on the Russian work culture persists. Russian workers still expect their employer to provide meals, transportation, housing, and daycare. Despite the enormous costs involved, many enterprises continue to do so. Under the Soviet system, the employer was not an equal and independent member in a negotiated labor contract, but an integral and permanent part of the worker’s life. Employment itself was more than just a right; it was one’s obligation and umbilical cord to the state.

All Russian citizens felt the impact of the Soviet system’s collapse. However, for the tens of thousands of weapon specialists in closed cities around Russia, the system has actually changed very little. Their employer is still the state, and the most important part of their remuneration is not the wage, but the social benefits, most notably housing. Underpaid and underemployed as a result of Soviet-like labor hoarding by the institutes, these individuals lead lives not radically different from those experienced during the Soviet years.

This minimal but secure standard of living must be oddly comforting to those who know no other economic system. Confined to the defense industrial complex, the weapon specialists are still guaranteed housing and a stable income. Furthermore, many believe that in time there will be future contracts that will reinvigorate the institutes. Moonlighting in an evening job or accepting grants from Western nonproliferation programs serves as an additional financial cushion that further discourages them from leaving the defense sector.¹⁷ If a weapon specialist leaves the institutes, he loses not only his housing and financial security, but also his professional identity.

Under these circumstances, employment in the defense sector is considered more stable and secure than in the private sector. Unless Russian work attitudes and behaviors adjust to a market economy and there is a clear incentive, Russians, old and young alike, will not view employment in the private sector as a desirable alternative.

Top-Heavy Russian Management Style.

The typical management structure in Russia is top-heavy, inflexible, and inefficient. Not only does this adversely affect the profitability of the enterprise, it creates an environment unconducive to the development of employees' entrepreneurial skills. Enterprises in Russia tend to be centered on a dominant individual instead of a board of directors or an abstract concept such as a mission statement. A general manager tends to be highly involved in every aspect of the enterprise's activity. Authority and responsibility are rarely delegated to the members of the management team, who have little opportunity to exercise or develop leadership or decisionmaking skills. Nor do they seek out extra responsibility. Because the general manager micromanages all daily operations, he has little time to strategize or develop other business opportunities.¹⁸ According to Andrew Cranston, a partner at KPMG Moscow,¹⁹

The lack of responsibility and autonomous management structure creates a very inefficient situation; workers are afraid to take decisions and a general manager's time is wasted on details. It is the rule rather than the exception to see queues of workers, including mid-level and higher-level managers, waiting hours in front of the executive director's door to ask even the most trivial questions.

Management consultants report that the majority of their Russian clients suffer from gross inefficiency due to a weak mid-level management structure, and often advise their clients to adopt the Western model of organizational management.

The top-down directive style carefully spells out the employee's duties and leaves little room for individual initiative. Lack of a mission statement or clear concept of what the company is trying to achieve often leaves the worker without direction or incentive to make additional efforts. Even with this direction, the average Russian employee could not count on any additional rewards for his efforts. In such a system, there is little reason for workers to assume ownership of their job or any initiative at all.²⁰

The belief that one can better one's situation through dedication and hard work, and that the reward received will be proportional to the amount of effort expended, is deeply ingrained in the Western work ethic. Workers in industrialized countries, in this sense, are basically entrepreneurs who sell their skills and services by contract to the highest bidder and constantly look to move up either within their current enterprise or with another employer. The concept that one can better one's position through hard work and dedication is stunted in Russian enterprises by the top-heavy management style along with a lack of basic entrepreneurial skills, initiative, self-motivation, and the ability to see the broader picture.

Russia's Past Laws at War with Private Business.

Until recently with passage of new laws, Russia's outdated labor code discouraged enterprises in Russia from creating more jobs and preserved rigidity in the labor market by imposing on the employer Soviet-era obligations that dramatically increased labor costs.²¹ For example, Russian workers were ensured a minimum of 4 weeks of annual paid leave in addition to the ten national holidays, plus unlimited paid sick leave at a rate of 60-100 percent of salary.²² Heavy compensation for overtime was also stipulated by the code.²³ Maternity leave in Russia was very liberal compared to that in most Western countries, providing as long as 3 years per child. These statutory requirements often crippled small- and medium-sized businesses.

The dismissal process favored the employee to the detriment of the enterprise. Under the old labor code, terminating employment was a very difficult and complex process for the employer.²⁴ Most companies found it necessary to seek costly legal consultation before undertaking action due to the detailed requirements. Further contributing to the risk faced by employers in the hiring process, trial periods could not exceed 3 months and in some cases were forbidden completely.²⁵ An enterprise in Russia was therefore reluctant to create new jobs due to the possible costs and difficulties in dismissing non-performers.

The Russian tax rules were also complex and confusing, laying a heavy burden on small- and medium-sized enterprises. As a result, these enterprises either evaded paying taxes or delayed paying as long as possible.²⁶ Tax collection, already inadequate, was further degraded by opacity in the private sector, as discussed previously. This reduced revenue in turn adversely affected the Russian government's ability to develop adequate social safety nets, since the system was funded by the payroll tax.

Throughout 2001, President Vladimir Putin and the Duma addressed many of these problems through significant economic reforms, including changes to Russia's social security and tax regulations.²⁷ In addition, on December 31, 2001, Putin signed a new, improved labor code into law.

The extent to which these reforms will be implemented and enforced remains to be seen. Employers may take advantage of eased restrictions on dismissing staff, but will they be eager to report all their earnings to the tax collectors? More important, the Russian worker, as we have seen, is not used to a labor market in which an employee's value is based on performance. Will the workers accept the new conditions, or will they seek out organizations that still provide Soviet-era privileges—for instance, state-sponsored military and nuclear industries?

A final concern is Russia's continued lack of consistent and fair enforcement of the legal protections. This deficiency affects every aspect of Russian society and creates considerable problems for business. Many potential investors have an understandable lack of confidence in the Russian judiciary system's ability protect their interests. Also, the laws that would protect property rights are either nonexistent or very complex, and in any case unfavorable to foreign ownership.

Practical Experience Points to Elements of a Solution.

When looking for ways to overcome the obstacles caused by Russian nonentrepreneurial work culture, one will find the experience of multinational corporations useful. These organizations have been doing business in Russia and employing Russians since well before the collapse of the Soviet Union. Competitive modern corporations cannot afford the inefficiency and inflexibility inherent in Russian enterprises, nor are they willing to tolerate corruption. At the same time, they rely heavily on locally hired staff. As a

result, they have devised several methods of addressing these concerns.

Multinational corporations have acknowledged that, in addition to the cultural differences, there are also generational differences among Russian workers, so that management style must be adapted to each generation accordingly. The first generation of Russian workers is composed of individuals over the age of 35, commonly referred to as the “Soviet generation,” i.e., those acculturated to Soviet labor process. The Soviet generation shows great difficulty in adapting to the new working environment. Accustomed to a top-heavy management style, they require strong leadership and close supervision. But with clear-cut direction and explanation of what is expected of them, they have proven to be very hard workers within the scope of their duty description. Initiative, too, never seems to develop to a significant degree in this age group. Multinational corporations have found that this generation never truly feels comfortable with decisionmaking and tends to defer all but the most trivial decisions to management.²⁸ Unlike most indigenous Russian enterprises, multinational corporations with prestigious names and high salaries can attract top candidates and usually pass over members of the Soviet generation in favor of younger Russians.²⁹

Younger Russian workers are generally much more adaptable than their “Soviet” counterparts, although their cultural background still plays an important role in the way they work.³⁰ Multinational corporations maintain a high percentage of expatriate staff to act as mentors to the local staff. These Western mentors not only help their Russian colleagues to learn their trade, but also expose them to the standards of a different work ethic. Often-times, this exposure is all that is required for the local hire to adapt successfully. The local hires remain uniquely Russian in regards to work culture, but learn to adopt critical elements of the Western culture that increase their entrepreneurial skills.

A similar approach is to send the Russian employee on assignment to a branch of the company in a Western country for periods of up to a year. Besides immersion in the Western work culture, this tactic has the added benefit of increasing the employee's foreign language skills.

These simple approaches have been successful in producing employees who see the big picture and demonstrate initiative and decisionmaking skills. Multinational corporations found that once these cultural issues have been addressed, the positive aspects of the Russian work culture can be put to use to a greater extent. These aspects, coupled with their excellent tradition of education, can make Russians valuable employees.³¹

Where Do We Go from Here?

Although the U.S. Government can immediately improve the effectiveness of its cooperative threat reduction programs by focusing on younger Russians, in the long run the best way to assure Russian demilitarization and nonproliferation is for the Russians themselves to get serious about creating a strong globally integrated market economy. To do this, the Russian government must finish creating a coherent legal framework in which business can prosper and ensure that future generations of Russians are adequately prepared to do business—Western style. Specifically,

- **U.S.-Russian nonproliferation programs must focus less on the existing cohort of weapons specialists and more on prospective weapons workers.** Towards this end, more research needs to be conducted to answer several questions. Who is most likely to consider work in the military and nuclear complexes more attractive than in the private sector? How large are future cohorts of weapons specialists likely to be? What factors do individuals consider when deciding which career field is more attractive? What alternatives exist that fulfill their

expectations? What kind of programs would encourage them to choose careers in the private sector?

- **Business and academic mentorship program opportunities involving training in Western countries need to be offered to Russian scientists and engineers under the age of 35.** In these programs, specific Russians should be matched to individuals from the West on the basis of academic or business compatibilities. The Westerners would act as mentors whose advice could be sought at any time, not just during a series of visits lasting 6 months to a year. The mentors themselves would need to be from the private sector. The program would have two phases—calibrated to the age and professional development of the Russian enrolled, as follows:

- Academic Phase.** Russian science and engineering university students should train for a year in the country of their mentor. It is important to the success of this project that the hosting university accepts only a small number of Russians involved in the program at any one time. These students would be encouraged to work part-time to begin exposure to the Western work ethic.

- Business Phase.** Russians under 35 and those who have already completed their studies should be matched up with professionals of similar background currently working with private Western companies. The program would start with either a 6-month or year-long paid working placement with the mentor's company. The placement would not only expose Russians to the Western work ethic, but also allow them to see firsthand how their own skills can be applied to the commercial market. Several short visits would be scheduled on a regular basis to maintain the contacts and maximize exposure.

- **The Russian government must create a business-friendly environment.** Current legislation must be simplified and reflect the requirements of a market economy. Property ownership laws must be clear and

defended equally under Russian law. The tax system must be simplified, and the burden on small and medium sized enterprises lightened. Finally, the new labor code must be enforced to ensure that rules of dismissal are made more lenient for the employer.

The Potential for Change.

Taking these steps will not be easy for Russia, but there are historical precedents indicating that cultural exchanges with the West can have a tremendously beneficial impact. In the 17th century, Russia was isolated from Western Europe and struggling through a period of stagnation. Peter the Great realized that, for Russians to pull themselves into the modern world, they needed to orient towards the West. Military and business practices were drawn on from Sweden, Prussia, and the Netherlands. Russians were sent out to learn Western skills, which they did without abandoning their own traditions or customs. The process of Westernization not only pulled Russia out of obscurity, but also ushered in Russia's Golden Age.³² Through reexamining current U.S.-Russian nonproliferation efforts and maximizing cross-cultural exchanges, over the next 2 decades there is good reason to hope that the following improvements can be achieved:

- A greater percentage of younger Russians, now armed with the skills to succeed, will chose to work in private business over the public sector.
- Of the existing cohort, 75 percent will have left Russia's military and nuclear complex though natural attrition, and their numbers will not be replaced.
- The anti-American sentiment in Russia will decrease, which will help avoid or resolve future conflicts.
- There will be an increased cause for foreign investment, which will strengthen the Russian economy

without the state becoming more of a threat to global security.

ENDNOTES - CHAPTER 8

1. In fact, individuals who have been acculturated to the Soviet labor process have a very difficult time transitioning to a market economy, and have little chance of becoming successful businessmen. Those who have the skills and motivation to do so, already have, regardless of any government program. In any case, within the next 2 decades over 75 percent of these weapons specialists will be past the age of retirement. Valentin A. Tikhonov, *Russia's Nuclear and Missile Complex*, Washington, DC: Carnegie Endowment For International Peace, 2001, p. 73.

2. *Ibid.*, p. 74.

3. Mark Galeotti, "Crime, Corruption and the Law," in *Russia after the Cold War*, eds., Mike Bowker and Cameron Ross, Harlow, England: Pearson Education Limited, 2000, p. 137.

4. Lesser offenses resulted in fines paid to the village elder, often in the form of vodka.

5. C. Feirson, "Crime and Punishment in the Russian Village," *Slavic Review*, Vol.46, No.1, 1987, pp. 55-69.

6. W. Clark, *Crime and Punishment in Soviet Officialdom*, London and New York: Armonk, 1993, pp. 31-35.

7. Leonid Brezhnev, while Soviet premier, was reported to have said, "No one lives on wages alone. I remember in my youth we earned money by unloading freight cars. So, what did we do? Three crates or bags unloaded and one for ourselves. That is how everybody lives . . ."

8. In PricewaterhouseCoopers' opacity index report released in April 2001, Russia was next to last of 35 countries reviewed. Only China has more negative factors for doing Western-style business.

9. Arthur Haigh, interview in *Kommersant-Daily*, January 26, 2001. See http://www.pwcglobal.com/ru/eng/ins-sol/issues/01-02-26_ah.html.

10. During subsequent interviews, the management made it clear what standards the employees needed to abide by. Since then, they have had no further incidence of cheating.

11. Haigh.
12. Alastair McAuley, "Social Policy and the Labor Market in Russia During Transition," in Joan M. Nelson, Charles Tilley, and Lee Walker, eds., Washington, DC: National Academy Press, 1998, p. 223. See <http://www.nap.edu/html/transform/contents.htm>.
13. *Ibid.*
14. This remained law in the Russian Federation until 1991. *Ekonomika i zhizn'*, No.22, 1991.
15. McAuley.
16. *Ibid.*
17. Matthew Partan, "Defense Conversion: How Far Can Russia Expand Small and Medium Enterprises?" Chapter 7; and Mark Kramer, "Demilitarizing Russian Weapons Scientists: The Challenge" Chapter 6; both in the present volume.
18. Andrew Cranston, Partner, KPMG Moscow, interview by author, March 2001.
19. KPMG Moscow provides accounting and management consultancy services to all sizes of Western and Russian-owned enterprises across Russia. This exposure gives it a unique perspective of the actual business climate in Russia.
20. Paddy Wright, Human Resources partner, KPMG Moscow, interview by author, March 2001.
21. Russia's previous labor code hadn't changed much since 1971 and was actually only a slightly modified version of the Soviet labor code.
22. Price Waterhouse, *Doing Business in the Russian Federation*, New York: Price Waterhouse World Firm Services BV, 1997.
23. *Ibid.* The workweek is set at 40 hours over a 5- or 6-day week, and the legislation is also specific about permitted working hours.
24. *Ibid.*
25. For employees under the age of 18 and for recent graduates of universities, institutes, and vocational training institutions.

26. James Leitzel, "Rule Evasion in Transitional Russia," in Joan M. Nelson, Charles Tilley, and Lee Walker, eds., Washington, DC: National Academy Press, 1998, p. 118.

27. Andrew Jack, "Moscow Ushers in Reform of Labour Law," *Financial Times*, London, January 5, 2002.

28. Cranston.

29. *Ibid.*

30. Wright.

31. *Ibid.*

32. Geoffrey Hosking, *Russia: People and Empire, 1552-1917*, London: HarperCollins, 1997, pp. 75-120.

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